Chs. Boillon
$13½

AN ACCOUNT,

With Illustrations,

OF THE

SUSPENSION BRIDGE ACROSS THE RIVER DANUBE,

UNITING PESTH WITH BUDA AND THE ADJACENT COUNTRY,

IN THE KINGDOM OF HUNGARY.

DESIGNED AND MATURED UNDER THE COUNCILS OF COUNT STEPHEN SZÉCHENYI AND COUNT GEORGE ANDRÁSY.

BY WILLIAM TIERNEY CLARK, F.R.S.

CIVIL ENGINEER.

WITH ELABORATE ILLUSTRATIONS.

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ADVERTISEMENT.

The Publisher is confident that the present Work will be considered a valuable addition to the many existing ones on Engineering subjects, and be acceptable as well to the profession as to those who interest themselves in the great results of Mechanical Science.

The erection of the Suspension Bridge at Pesth, in Hungary, is especially worthy of record, not only from the importance and magnitude of the operations, but also from the peculiar difficulties encountered in their progress. The Publisher felt himself under great obligations to the late Mr. William Tierney Clark, who, although suffering severely from declining health, kindly placed into his hands the illustrations and detailed drawings of this magnificent Bridge, and also supplied him with all the information requisite for the successful completion of the Work.

The Work has been issued in Three Parts, with several plates in each; the whole now making a volume of Thirty-seven Plates. The text given comprises also the Report made to the Hungarian Diet by Counts George Andrásy and Stephen Széchenyi, who made a visit to this country for the express purpose of examining the various bridges to be met with here, and for obtaining all the information in their power, so as to enable them to recommend to the Diet the kind of bridge best suited, in their opinion, to the locality and the financial condition of their country.

A detailed description of the conduct of the operations, and such particulars as will afford useful information to the engineer and scientific enquirer, will be found to be added to the Work.

JOHN WEALE.

Nov. 1st, 1852.

LIST OF ENGRAVINGS.

REPORT ON PESTH BRIDGE.

THE experience of modern nations in everything relating to bridges is so various, that no one of them can be said to have exhausted the subject. Climate, temperature, locality, the velocity of the rivers, the condition of their beds, and the materials used for bridges, determine, in some measure, the experience each nation has acquired; and owing to the above circumstances, one nation may surpass another in some particular branch of practical mechanics, though, in other respects, less advanced. In a country where the winters are mild, the rivers rarely or ever frozen, and no run of ice in fearful and devastating masses,—where the banks are high, where stone is cheap and money abundant, matters assume a different aspect compared with a country where the winters are severe, the climate variable, the banks of the rivers low, and stone, especially of large dimensions, dear. Thus, in the North American States, for instance, where much damage and danger ensue on the breaking up of the ice in the rivers, bridges with stone piers and timber arches, of immense span, become indispensable, and are made of great strength and solidity, timber and materials being cheap in that country; whereas, bridges of stone and iron are best adapted to England, where the rivers are rarely frozen, the banks generally high, stone and iron comparatively cheap, and money easy to be obtained. In Russia and Northern Poland, where the winter suddenly sets in, and as suddenly breaks up, bridges of boats are usually adopted, and found to answer best. There the custom is, instead of removing the bridge, on the appearance of ice, to leave it to its fate, and, on the return of spring, to substitute a new one. The damages done to the old are repaired during the summer and autumn, and such portions as

are found serviceable reserved for future occasions. Other considerations must be taken into account, when it respects the load a bridge has to sustain, viz.: whether the bridge be intended for foot passengers only, or for general traffic; and whether that traffic be small, regular, and slow, or great, irregular, and fast.

It is our opinion, that upon these principles and conditions alone, and of course with reference to material and design, &c., every bridge ought to be constructed; for instance, suppose it to be possible that any one could be found to propose such a bridge as now exists between Malta and Gozo, which consists of a single rope only, as a means of forming a permanent and safe communication, between the suburb of Unter-Maimhartsberg and Vienna, and offer as a reason, that because it answers in its present site, it ought, therefore, to answer in the proposed one, we might justly ridicule the idea and consider it pure folly. Keeping these general conditions in view, it is our opinion that a permanent bridge between the two cities of Pesth and Buda must not be a matter of taste only, but of demonstration according to the laws of mechanics and mathematics.

The main question is, what kind of bridge ought we to have? Now to answer this without further waste of time, by remaining at home, and deceiving ourselves with the beauties and subtleties of theory, we determined on going to England, and there consulting with men of experience and skill. The reason for our proceeding to England in preference to other countries, we beg to be allowed to explain, was partly because all that relates to mechanical science has been there brought to the highest development; partly because, in this respect, practical results are almost without end: or, to speak more clearly, because far more has been done there worth going to see, than is to be met with on the whole continent of Europe; but principally for the reason that it stands in such close relations with North America, a country whose climate and other physical characters bear so striking a resemblance to those of our native land. We could have desired no greater pleasure than to have visited that country, but the approaching opening of our Diet so limited our time, that, independently of other reasons, this, of itself, would have prevented us; therefore, in order to make the best use of the short time

allowed us (a few months only), we chose England, as presenting the best and widest field for our researches.

According to our views, and as far as our limited experience enables us to judge, the chief difficulties to overcome are: 1st, the force of the ice and the inundations likely to arise from the contraction of the sectional area of the river, where naturally the shores lie so low, as, for instance, at Pesth and Buda; 2nd, the raising of the necessary capital, with a financial system so poorly developed as ours; and, 3rdly, the absence of a general co-operation in carrying out great undertakings.

A bridge which could be constructed without any piers in the river, or with the least number possible, we consider the most desirable; and, in fact, in our opinion such only ought to be adopted. This desideratum, at least as far as present invention has advanced, is comprised solely in the Suspension Bridge, where facility of construction, strength, and durability are combined with cheapness and economy. At the first outset, we sought to put ourselves in communication with men who made work of this kind their chief study, and who had turned their entire attention to the perfecting of the branch of art adopted by them, and whose existing works were sufficient proof of their skill and ingenuity. Although we cannot omit to mention with praise the politeness and affability with which we were in general received, still, in justice to ourselves, we may allude to the difficulty we experienced at the commencement in drawing attention either to ourselves or to the greatness of our object,—the real cause of which was, that the principal engineers of England, being continually engaged in works of great magnitude, looked upon the erection of a permanent bridge between Buda and Pesth as a matter of little difficulty.

Added to this, we appeared as foreigners from a nation little known in England, without any certainty as to our plan being carried out; while, as honourable men, we could give no other answer to the invariable question, "Is it likely that the work will be proceeded with?" than, "We hope so."

We had, however, the satisfaction of seeing that the plans furnished us by the Directors of the Government Engineering department attracted considerable attention: these plans, for which we are indebted to the kindness of the Arch-Duke Palatine,

represented the eourse of the Danube from Waitzen to Fôldvár, in all their detail, together with the neeessary eross sections, and although we can with diffieulty express the ehagrin we felt when we diseovered how little known we Hungarians were, by people in every other respeet well-informed—still, on the other hand, we saw with pleasure the surprise expressed at the exeellence and completeness of the plans, whieh they eould not too highly commend. It must, however, be eonfessed that the ignoranee of foreigners, with respeet to us, is less to blame than ourselves; a heavy load lies upon our shoulders for our own baekwardness, and it afforded us no small eonsolation when we saw the real value that was attaehed to our performanees, for we thus elearly foresaw the dawning of the sueeess whieh must ultimately erown the exertions of our nation, and the first spark of that holy fire, whieh, if not erushed and trodden under foot, swells the breast of man and stamps greatness on a nation. This feeling then, although it may be eonsidered of little eonsequenee, was to us of the greatest importance, for exactly in proportion as our undertaking ereated sympathy (whieh it was evident did not result from idle euriosity, but from a real desire to serve our native land), so did our zeal and endeavours increase. In mentioning these eireumstances, we beg to return our sineere thanks for all the information we obtained in referenee to our projeet, and to request the Honourable Committee to thank in the most marked manner His Imperial Highness the Areh-Duke Palatine, as well as the Honourable Board of the Government Engineers; for we feel that to the eorreetness and perfeetion of the plans furnished by them as above alluded to, we owe the obtaining of the information whieh we are about to lay before you.

Mr. W. Yates was the first with whom we eommunieated on the subject, and in order to enable the Honourable Committee to judge of the truth of our remark, viz. "How diffieult it was to engage the attention of the English engineer for any undertaking, whieh although it might appear almost impraetieable to us, appeared to him as trivial," we beg to be allowed to lay before you the following statistical data, whieh we purpose availing ourselves of occasionally for eomparison in the eourse of this Report:—

Mr. W. Yates is a partner in the firm of Walker and Yates,

gentlemen who are proprietors of an iron-foundry capable of converting and turning out weekly 200 tons of their own pig-iron in addition to 200 tons of bar-iron, making a total of 400 tons of iron manufactured weekly, which, by a little extra exertion, as they assured us, might be increased to 500 tons. Notwithstanding that they own several coal mines, and that their works are situated at Gospel Oak, near Birmingham, in a comparatively cheap district, still their monthly expenses amount to 12,000*l.* The Viceroy of Egypt, alone, has paid them for many years successively the sum of 100,000*l.* From this it will be seen, that two English gentlemen produce more iron from their private establishment, in one year, than does the whole of Hungary in a similar period; for we find that the produce of manufactured iron, taking into account every place under the crown of Hungary, amounts to no more than 300,000 centners, or about 16,500 tons. As regards the extent of the works of Messrs. Walker and Yates, they are very far from being the largest in England, and the reason why we applied to them in preference to others was, that all the largest cast-iron bridges of the day had been made at their works, and because it does not necessarily follow, that they who do most work do it best. The average quantity of iron annually manufactured in Great Britain is 500,000 tons, but a few years back the quantity was nearly 700,000 tons. The Waterloo Bridge cost one million sterling, and London Bridge about 1,200,000*l.* The railway between Liverpool and Manchester, which is about thirty-two English miles, or about seven Hungarian, was (if we remember rightly) estimated to cost one million sterling, but actually cost 1,200,000*l.*; the distance is travelled over in one hour and a quarter. The railway now projected between London and Birmingham is estimated at 2,400,000*l.*, but it is believed will cost 2,000,000*l.* The proposed erection of a pyramid which should contain 5,000,000 of corpses, is estimated to cost from 400,000*l.* to 500,000*l.* sterling.

Through Mr. W. Yates, we became acquainted with Mr. Tierney Clark, an engineer of whose talent and experience we could have no doubt, particularly in all matters relative to Suspension Bridges. He has erected the Hammersmith, Shorcham, and Marlow Bridges, the plans and drawings of which, with a description, we have the honour to lay before the Honourable Committee.

From this time forward we obtained much experience and information, and omitted no pains to elucidate more and more the practicability of our project. We subsequently made the acquaintance of other engineers of eminence, amongst whom we may mention Mr. James Walker, the celebrated Telford, Messrs. Hartley, Ogden, (the American Consul at Liverpool,) and Mr. Wright, from North America; and, in the course of this Report, we shall have several opportunities of referring to the opinions of these gentlemen in detail. Our progress was recorded daily in our note-book; and, from the tenor of our inquiries, we soon became convinced that the practicability of erecting a permanent bridge between Buda and Pesth was no longer doubtful; and although we admit the necessity of having recourse to men of first-rate experience, its success must ultimately depend upon the will of the Hungarian nation. We could come to no other conclusion: why should we despond, with the example before us of a country where, amid the blessings of universal freedom, each step leads to new wonders, the fruits of man's genius, presenting a noble beacon to all other nations?—why should we entertain a doubt, then, but that in Hungary, too, we were capable of producing such noble works as in England are to be found in great numbers, and which, as monuments to the enterprise of private men, are to be met with continually? Yes; we cannot but be convinced such things are for Hungary too; if not, at least, in so great a number: we require but the will of the nation for a few. We were, however, fully impressed with the feeling that, for the furtherance of our object, it required more than merely to convince ourselves and the Honourable Committee—it required that our data should be such as would convince the public at large, and put the practicability of the structure beyond a doubt.

The carrying out of our project never, in reality, appeared impracticable to us; but what could we inexperienced individuals do, other than investigate the matter to the utmost, and, by sound proof, clear away the mist which seemed to obscure the understandings of contending parties? It now lies in the hands of the great public to solve this problem; we must, however, admit, that the public ought not to be induced to stake their money and their rights upon an object, the carrying out of which is hazardous and fraught with danger: therefore, to remove all doubt upon this

point, we consider the best and simplest method is to lay before them accounts of similar undertakings, all of which have been crowned with success. For this purpose, then, we beg most respectfully to lay before you a variety of designs of English bridges in existence, and of such as we have been able to obtain, and which in our opinion are best suited for execution between Pesth and Buda. First of all, we requested several engineers to favour us with their answers in writing in respect to certain queries which we had drawn up on paper, and which, as a more business-like way of proceeding, would at the same time enable the parties to consider their answers better, and moreover, avoid all ambiguity upon such an important point, and set at rest the scruples of those who choose to read them. Had we not adopted this mode of proceeding, it is possible that many might have been found ready to persuade others that we had been led astray by our enthusiasm for the cause, and wished them to believe as we did.

There is now, however, no room for such a belief, for we have the pleasure to lay before you the well-considered opinions of men, whose experience, far from being based on theory, is founded on actual practice, and who value their own reputation too highly to risk an opinion which they cannot afterwards support and demonstrate according to the laws of science. We therefore beg to lay before you a translation of the questions sent in to Mr. Tierney Clark, C. E., with his answers to the same.

The Questions as proposed by the Count George Andrassy *and the* Count Stephen Széchenyi *to* W. T. Clark, C.E., *together with his Answers, respecting the erection of a permanent Bridge between* Buda *and* Pesth, 15*th September*, 1832.

First Question.—What kind of bridge would you recommend as being the best adapted for forming a permanent communication between the two cities of Buda and Pesth?

Answer.—I am of opinion that the description of bridge best adapted for either of the situations represented by the various plans and sections, for forming a permanent communication between Buda and Pesth, is a chain suspension bridge; as the limited number of piers it would require would oppose less obstruction to the flow of the water and ice than either a cast-iron or stone bridge. The approaches or ascent to a suspension bridge will be considerably less than those which would be required for either a cast-iron or stone bridge, and will consequently be cheaper in this respect. By referring to the sections of the river, it is evident that whatever the kind of bridge, the approaches must be of considerable length and height. To accomplish this it will require considerable outlay, which, however, may be much reduced by a judicious application of a dredging machine, to clear out the bed of the river; which, if I may be allowed to judge from the very perfect plans before me, would easily admit of very great improvement: so that, at the same time that you save money, you are carrying out a great public benefit.

Second Question.—Which is the largest suspension bridge in the world, and which has the greatest span between the piers?

Answer.—The greatest distance between the points of suspension of any bridge in existence is, I believe, the Menai Bridge, which is 570 feet; but the total length of the roadway supported on the chain is only 542 feet. The distance between the points of suspension of the Hammersmith Bridge is 422 feet; but the length of the roadway supported by the chain is 710 feet, or 168 more than is supported by the Menai Bridge.

Third Question.—What point between Buda and Pesth do you consider as best adapted for the erection of a bridge?

Answer.—It is difficult to determine which is the best situation between Buda and Pesth for the construction of a bridge without a personal inspection of the different sites from which sections have been taken; but any point between the sections *A B* and *a b* seem favourable. Below this the river widens very much, and the expense would be considerably increased without any apparent advantage.

Fourth Question.—Could not a bridge of one single span be thrown across

the Danube? And what do you consider the greatest length of space which could be adopted safely, and without disagreeable oscillation?

Answer.—A bridge could be erected over the river at any of the narrow sections to the extent of from 1000 to 1200 feet in one span, without danger or unpleasant oscillation; but I should advise having a bridge with two spans in preference.

Fifth Question.—How many piers do you consider it necessary to have in the water, in order to make a suspension bridge safe?

Answer.—The number of piers will entirely depend upon the situation which may be chosen for the erection of the bridge.

Sixth Question.—Do you not think that the ice would carry away the piers; for at times its force is beyond all conception?

Answer.—If the piers are properly constructed, there can be no danger of their being carried away by the ice, however massive and powerful it may be.

Seventh Question.—Would not the piers tend to an accumulation of ice, so as to impede the flow of the river, and thus cause serious and dangerous inundations?

Answer.—As all the ice and water passes through the narrowest section of the river at *C D*, and as the sectional area of the piers would be but small, the river between the sections *A B* and *a b* would still be equal in area, if not greater, to the narrowest section *C D*; and, consequently, there would be no increased tendency to the accumulation of ice.—(Having had a personal interview with Mr. Clark as to the purport of this answer, we obtained the further following verbal explanation, viz.:—that he could in no case recommend a bridge to be erected at the narrowest part of the river, either with one or more piers, since by such means the danger of increasing the accumulation of the ice would be great, and perhaps be the cause of devastating inundations. To this we made the remark that, although the breadth of the river at *C D* was considerably smaller than at *A B*, or *a b*, still the river was much deeper, and therefore could carry off more water and ice than at any other point. He answered, with respect to the quantity of water passing off, Your views are right; but, as the ice, for the most part, floats on the surface, the result would be quite different. He, however, concluded by referring us to his *First Answer*, in which he called attention to the absolute necessity of deepening the bed of the river.)

Eighth Question.—Is there any probability of the chain by which the bridge is supported, breaking?

Answer.—If the chains are made with the best wrought iron, and the usual and precautionary measures be taken as to the quality of the material, workmanship, and proof by a constant supervision during their manufacture, and their section be proportioned according to the load to be suspended, there can be no danger whatever of the chain breaking.

Ninth Question.—Is there no danger to be apprehended of the piers giving way, and being pulled over?

Answer.—If the piers are properly proportioned to their load and other contingencies to which they may be subjected, and are built with the usual and necessary precautions, there is no danger whatever of their being thrown down.—(*Note:* We cannot omit here calling attention to the expression which Mr. Clark makes use of in the *Eighth* and *Ninth Answers*, where, in speaking of the strength of the chains, he says, "if the usual precautionary measures are taken;" and with respect to the piers, again he says, "if they are built with the usual and necessary precautions:" we think it necessary to explain what is here meant, and which cannot but be considered as an extraordinary proof of the manner in which professional works are conducted in England. Mr. Clark says, "usual manner;" now these words do not mean indifference or neglect, as we find the common interpretation to denote, but rather perfection; for were our works in this country to be carried out according to the every-day interpretation of the word "usual," I should feel very great objection to trust myself on a suspension bridge constructed under such supervision.

Tenth Question.—Might not the natural elasticity of the iron, when acted upon by stormy weather, occasion a dangerous amount of undulation, which, if not injurious to the structure itself, would appear dangerous?

Answer.—I am of opinion, from my experience in this country, that the vibratory motion of the bridge would not be injurious, nor excite apprehension, in stormy weather.

Eleventh Question.—Are you aware of the existence of any house that would undertake to ensure the bridge against the following, viz.:—

a. The ice carrying away the piers.
b. The piers in the water causing an extraordinary stoppage of the ice, and thereby serious inundations.
c. The breaking of the chains.
d. The giving way of the piers, or sinking of their foundations.
e. The existence of unpleasant vibrations?

Answer.—I do not know of any establishment in this country which would undertake to ensure against the risks referred to under the heads *a, b, c, d, e.*—(*Note:* Mr. Clark could give us no satisfactory answer to this question. As engineer, he did not interest himself in the arrangements of assurance companies. We shall, however, further on, again refer to this question.)

Twelfth Question.—What do you consider would be the weight of the chains for a bridge between Buda and Pesth?

Answer.—The weight of the iron-work will entirely depend upon the span of the bridge, its versed sine, and the load the bridge will have to support. But before this question can be answered correctly, the situation of the bridge must be finally determined. In order, however, to place in the hands of the Company something tangible, until the time arrives for commencing

the works, and in order that they may be able to estimate their means, I have prepared several plans, with rough estimates, the estimate being computed according to English prices.

Thirteenth Question.—Might not the iron-work be manufactured in Hungary?

Answer.—Not being acquainted with the nature of the wrought and cast-iron of Hungary, or the means the manufacturers have for making the links, and other iron-work, with the degree of accuracy and precision so essential to the stability of a suspension bridge, it is impossible for me to give a decided opinion on this point; but, judging from the iron-work usually made abroad, I should think it could not be done without considerable risk and danger.

Fourteenth Question.—Of what kind of iron should the bridge be made—of cast or wrought iron?

Answer.—The chain links, vertical rods, pins, gudgeons, and bolts, must be made of the very best description of wrought iron, and under continual supervision, and subject to proof. The beams, truss-columns, retaining-plates, &c., should be made of cast-iron, of the very best grey pig.

Fifteenth Question.—What would be the price of such iron per ton?

Answer.—The price of the wrought iron work in London would be about 24*l.* per ton; the cast-iron work, about 10*l.* per ton.

Sixteenth Question.—What would the expense of freight per ton be from London to Fiume, including loading and unloading, together with the insurance?

Answer.—The freight per ton, including insurance, &c., to Fiume, would be about 1*l.* 6*s.* 6*d.*

Seventeenth Question.—What is the tenacity per square inch of English iron?

Answer.—An inch square bar of English iron begins to stretch with a weight of from 10 to 12 tons, and breaks with from 24 to 27 tons weight.

Eighteenth Question.—How is the tenacity of the iron determined?

Answer.—The iron can be proved in a machine constructed of simple or compound levers. A graduated scale then attached, from which the tension the iron is subjected to, may be read off during any period of the experiment from its first stretching to the time of its breaking.—(*Note:* These two answers can be only properly understood after personal inspection of the machine in use.)

Continuation of Questions and Answers on the 20th October, 1832.

Nineteenth Question.—Of what length and breadth would the piers, which stand in the river, require to be; and how deep must the foundations be carried?

Answer.—The breadth, length, and depth of the piers will depend on the width of the carriage-way, the span of the bridge, the depth necessary for the foundations, the height above the highest water necessary for the navigation,

as well as the dip of the chains; in short, the site of the bridge must be fixed, before a correct answer can be given to the question.

Twentieth Question.—What stone would be required for building the piers?

Answer.—Any kind of stone that can be obtained in large blocks, capable of resisting the weight to be supported, and the effects of the weather.

Twenty-first Question.—What is the price of the stone, as used in England, for such works?

Answer.—The price of stone used in this country varies from 4*s.* to 5*s.* per cubic foot, which includes all expense in labour, setting, and dressing.

Twenty-second Question.—What is the price of labour in England?

Answer.—The price of manual labour varies in proportion to the ability of the labourer.

A Mason is generally paid from			5*s.* 6*d.*	to	6*s.* 0*d.*	per day.
A Bricklayer	„	„	5*s.* 0*d.*	„	5*s.* 6*d.*	„
Smiths	„	„	5*s.* 0*d.*	„	8*s.* 0*d.*	„
Carpenters	„	„	5*s.* 0*d.*	„	6*s.* 6*d.*	„
Common Labourers	„		2*s.* 6*d.*	„	3*s.* 6*d.*	„

Twenty-third Question.—Would it not be advisable, for the greater security of the structure, to erect ice-breakers in front of the piers?

Answer.—The piers of themselves would form buttresses or "cutwaters," and be quite adequate to resist the effect of the ice, without any other assistance whatever.

Twenty-fourth Question.—What is the most desirable kind of foundation on which to build such piers?

Answer.—Rock of sufficient solidity, strong clay and gravel.

Twenty-fifth Question.—Would it not be advisable to protect the masonry of the piers by means of a cast-iron covering?—This is not proposed because we have any fear of the force of the ice, but because we feel a little anxious as to the stability of the piers when the chain comes in contact with them.

Answer.—This precaution I consider to be wholly unnecessary, because the chains are not fastened to the piers; but, on the contrary, only rest upon them on a system of rollers, in order to admit of their moving freely backwards and forwards.

Twenty-sixth Question.—Would not the structure be exposed to great risk, owing to the expansion and contraction of the chains under change of temperature?

Answer.—From the experience I have had, I am of opinion there is no danger to apprehend from the effects of heat or cold on the iron-work.—I am borne out in this opinion by observations made at St. Petersburg, where the mean greatest cold is 23° Fahrenheit below zero; and this intensity does not appear to have had any detrimental effect on the two small suspension bridges which are thrown over the Fontanka Canal, one being 184 feet between the points of suspension, and the other 150 feet. "If we only glance at the

construction of the different parts of a suspension bridge, we must at once lose all anxiety as regards its stability; for, as it will be seen by reference to the plans, the chains hang free from one extremity to the other, and consequently are capable of adjusting themselves, in case of any expansion or contraction taking place."

Twenty-seventh Question.—Do you think that the iron-work, in cases of thunder-storms, would be exposed to danger from electricity?

Answer.—I have never known any instance where the electricity has taken effect.—(*Note:* In England, thunder-storms are of rare occurrence; and as we do not consider this question superfluous, we shall take another opportunity of referring to it.)

Twenty-eighth Question.—Do you not consider it absolutely necessary that some experienced engineer should make a personal inspection of the proposed sites before the bridge is commenced; and would it not be further advisable that such person should reside a winter at Pesth, in order to see the effects of the breaking up of the ice?

Answer.—Certainly; I think that the most proper person to go over would be the person who might be entrusted with preparing the design; and I think this could not be efficiently done without taking a view of the spot.

Twenty-ninth Question.—Supposing it should be determined to erect a suspension bridge, would you have any objection to undertake its construction?

Answer.—I should have no objection whatever to undertake its construction.

Thirtieth Question.—In the meantime, until the whole is decided upon, would you undertake to furnish us with several working designs, and the necessary detail drawings?

Answer.—Yes, provided I am engaged to undertake its erection.—(*Note:* By these plans Mr. Clark understands drawings, which should denote the minutest detail, and the preparation of which requires so much time, that no one in the profession could be found who would undertake them, without having, as a remuneration for his trouble, a share in the construction of the work, or be handsomely paid. To prepare plans in England is so expensive, that our private Hungarian purses would have been inadequate to pay for them. We therefore considered it advisable to give up the idea of procuring a complete set of detail working drawings; first, because the actual site of the bridge was not fixed upon; and secondly, because we were not certain of its being actually carried out. Under these circumstances, therefore, we deemed it advisable to procure a general design only, but one which would at the same time be comprehensive, and give a general idea of the plan proposed.)

Thirty-first Question.—What would be the cost, including all contingencies, of a suspension bridge, supposing it to be erected at the section *A B* or *C D*, according to your English prices?

Answer.—According to my computation, a bridge, according to the design

marked No. 1, would cost about 143,000*l.*; according to the 2nd design, about 151,000*l.*; and according to the 3rd design, about 127,761*l.* sterling. I must, however, be allowed to observe, that these calculations are only so far correct, inasmuch as the sections are right; and every allowance must be made for the natural difficulties of the locality, which are wholly unknown to me.—(*Note:* This is the reason why we wished the prices calculated according to English ones, for by that means we could readily form a comparison by obtaining the relative prices of labour and material in this country, as compared with England.)

Thirty-second Question.—What do you consider would be the annual cost of keeping a suspension bridge in repair?

Answer.—I cannot undertake to answer this accurately, it depends on so many different circumstances; but the total expense of keeping the Hammersmith Bridge in repair for the last five years has not exceeded 100*l.* per annum.—(*Note:* The cost of the Hammersmith Bridge was about 48,000*l.* the cost of repairs per annum, 100*l.*, and consequently not more than $\frac{1}{11}$ per cent. per annum.)

Thirty-third Question.—Is there any establishment that would undertake the cost of maintenance, or secure us against the possibility of the estimate being exceeded?

Answer.—I do not know of any such establishment.—(*Note:* This question has reference to *Question No.* 11, and, as there observed, we shall refer to it further on.)

Thirty-fourth Question.—What time do you consider necessary for the construction of a bridge between Buda and Pesth, from the day of agreement to the day of opening?

Answer.—Not being aware of the facilities the country affords for conducting such a work, I cannot answer this question; but I should think it might be completed in from three to five years from the commencement.

Thirty-fifth Question.—At what fixed periods must the payments be made?

Answer. — This would entirely depend on the agreement with the contracting party.—(*Note:* We shall take another opportunity of referring to this important question.)

Thirty-sixth Question.—Would it not be advisable to construct either a cast-iron or stone bridge in preference to a suspension bridge, if we take into consideration the great amount of traffic of all kinds which it would be impossible to restrain within limits; and the enormous force of the wind in storms?

Answer.—I apprehend that a stone or cast-iron bridge would, from the number of the piers necessary, cause very considerable impediment to the flow of the river and ice, and consequently cause more frequent and serious inundations than heretofore.

Thirty-seventh Question.—Do you consider it advisable to construct

suspension bridges in such exposed thoroughfares, as, for instance, between Buda and Pesth; and would the security of the bridge require a system of police, whose duty it should be to prevent too rapid movement on the platform, as well as too great a load being on it at any one time?

Answer.—A chain bridge can be made capable of resisting the force of storms, as well as any amount of traffic, no matter what its velocity. I think the intervention of the police might be of service, not to insure the stability or safety of the bridge, but to put down all excesses, and prevent damage to the works, as well as prevent accumulation of manure and dirt on the platform.

Thirty-eighth Question.—Is the iron-work liable to be deteriorated by the effects of corrosion, and thus endanger the permanency of the structure?

Answer.—The iron-work will suffer little or nothing from corrosion, as it is usually protected from the action of the air, in the first instance, by heating, and then submersion in a bath of boiling tallow, after which it is painted with three coats of good paint. This method has been found to answer perfectly, so that one or two coats of paint, once in two or three years, according to circumstances, has been found to answer the purpose of preventing oxidation; and this method is attended with little expense.

(Signed) W. TIERNEY CLARK.

Hammersmith, 10th November, 1832.

Such, then, are the answers handed in to us by Mr. Clark; if, however, there should be any want of logical arrangement in the foregoing, we beg that the Honourable Committee will attribute it to the fact, that two series of questions were sent in, on two different occasions, the answers to which, for the sake of better reference we were unwilling to separate, are placed in succession under the same head; from which it will be seen that, in several instances, after an answer has been given, a question follows which appears to have no reference to the foregoing one. This, however, originated from the first answer containing reference to matters with which we were at the time unacquainted, and which we could not have foreseen. On the other hand, we must also beg to excuse the broken and disconnected manner of our investigation, on the plea of having had to make use of the English language, in which, at that time, we were not very great adepts; and, further, the reason that our inquiries were not so comprehensive as they might have been, we must again beg to observe, was, that having undertaken this investigation on the score of good-will, we lacked the courage, or, if we might so express

ourselves, the pedantry to heap searching question on question, and because we saw that Mr. Clark could badly afford to abstract so much of his time from his other great works to investigate a project at the time in embryo only. We had enough to do to get Mr. Clark to give us the few answers herein alluded to, which will be fully appreciated, when we assure the Honourable Committee that, notwithstanding our continual exertions and pushing, nearly two months had elapsed before we obtained the answers and plans we have now the honour of laying before you. We have, however, now the satisfaction, until the proper time arrives, of possessing in manuscript the opinions and views of an engineer, who, although he has neither grown grey nor old in his appearance (he is in the prime of life), still possesses as much practical knowledge as any other; and, although silent upon this point himself, still his works speak loudly in his praise.

This autograph we shall always consider, as a valuable result gained by our indefatigable exertions, since we hope and trust that the opinions of a practical man, of acknowledged talent, cannot but tend in a great measure to unite the views and opinions of those who consider our scheme impracticable, and our trouble as thrown away; and let us further hope that all well-wishers to their native land will join hands, and give us their united influence, with the determination to carry out and complete this undertaking, and not allow themselves to be led away by their prejudices. If, then, the opinions of such an experienced engineer can have no weight, what weight ought to be attached to the prattle of the wise-heads of the Coffee-house, who never in their lives saw a good bridge, and who, although they set themselves up as the champions of theory, have never so much as erected a gangway, nor a paltry wooden bridge, but who still feel themselves competent to dispute the possibility of a bridge between Buda and Pesth; and why? because they would be sure to fail in the erection of such a work.

It may, however, be urged in opposition to Mr. Clark's knowledge and experience, that as all his works have been confined to England alone, where, in comparison with our country, there is no winter and no great rivers, it is impossible for him to appreciate the enormous force of the Danube in winter; and in consequence, if we may be allowed to use the expression, his experience is

English only. Mr. Clark, too, was of this opinion, so that when he, in conjunction with Mr. Yates, was called upon by the Russian Government to erect a suspension bridge and other works at St. Petersburg, they commissioned Colonel Colquhoun, of the Royal Artillery, to proceed to St. Petersburg, in order to make observations on the temperature, the freezing of the Neva, the breaking up of its ice, its velocity, &c., and numerous other important matters.

From this fact we must consider his experience and knowledge as extending not only to England, but to Russia also, and, therefore, in some measure to Hungary; for, although with us the cold is severe in the winter, and our Danube a mighty river, yet in St. Petersburg the winter is by no means warm, nor the Neva a petty stream.

Notwithstanding all this, we considered it of the first importance in such matters to procure the very best opinions possible for our guidance, and, in consequence, did not confine ourselves exclusively to Mr. Clark; but, on the contrary, submitted the principal questions to other eminent engineers. With Mr. Telford we had, therefore, the following conversation:—

Question.—We wish to construct a bridge in Hungary, the length of which may be taken at 1600 feet. There are many of us who consider such an undertaking impracticable, and think that it would be either carried away by the ice, or cause such a stoppage in the river as to occasion extensive inundations. What is your opinion?

Answer.—It is difficult to answer this question at once, without a previous knowledge of the locality.

Question.—What do you consider the depth of the river? and what is the nature of its bed?

Answer.—Five to six fathoms, with a bottom chiefly of sand. The depth is insignificant; but the sand! the sand! that is a great evil.

Question.—And why? Is it not possible to overcome this difficulty?

Answer.—Why not? we have means enough at our command to provide against it; but rock or clay were better. For the rest, you need not have the least apprehension of stoppage to the ice, or inundations in consequence, if due precaution be taken to have the supporting piers at a sufficient distance from one another.

Question.—What kind of bridge would you recommend? and what do you consider as the greatest available span, and at the same time the least dangerous?

Answer.—This can only be determined from a knowledge of the locality; suspension bridges admit of the largest spans. I have prepared a design for

the city of Glasgow, of a bridge a 1000 feet span; but I consider spans of from 500—600 feet (like those of the Menai Bridge, which I built) to be the most advantageous. The piers of this bridge would not care much about the ice of your rivers; they would laugh at it. With respect to the effects of the ice, I have a great deal of experience, having constructed many bridges in Scotland, where the natural difficulties have been greatly increased, owing to the velocity of the river and the force of the ice. But, Gentlemen, allow me to observe, we do not consider any thing impossible. Impossibility exists only in the prejudices of mankind, to which some are slaves, and from which few are able to emancipate themselves, and enter on the path of truth.

Question.—While on your bridge at Menai, we did not experience any extraordinary motion, although men, carriages, and horses were passing and repassing; but when only six men ran along the platform, each keeping step, we did experience a sensible motion. Would not, therefore, this kind of motion be much greater in a bridge between Buda and Pesth, where the traffic is many times greater, and where the river is so much wider, than at the Menai Strait? [*Note:* The drawings of this bridge we now beg to lay before you.]

Answer.—Suppose the bridge to have a little motion, it is of no consequence, and can do no injury; so that, notwithstanding the great traffic between Buda and Pesth, I do not consider that you could construct a safer kind of bridge; however, should it be necessary to avoid motion altogether, then I should recommend you to erect a cast-iron bridge of three spans, each 400 feet; such a bridge will have no motion, and though half the world lay a wreck, it would still stand. The three piers, which would thus be necessary in the river, could in no case require more than a width of 75 feet; and, while they would be irresistible to the strongest ice, they would not occasion any extraordinary inundation in so broad a river. Whether you have sufficient money for such a bridge, is quite another question, and one which I cannot answer. I will, therefore, confine myself to this observation, that the cost of a cast-iron bridge of three arches would be, at least, double the cost of a chain bridge, since for the latter a less number of piers would suffice. The bridge over the Menai Strait did not cost much more than 70,000*l.*

Question.—Does the maintenance of the Menai Bridge require much outlay?

Answer.—It requires nothing more than now and then a fresh coat of paint. The piers are hollow, so that their internal structure may be seen, and examined at any time.

Such was the result of our conversation with Mr. Telford; but as he had not the time to answer our questions in writing, we took the precaution to make him understand, in as clear a manner as

possible, that we considered his opinion as proceeding from a great authority; and that in making our report we should commit his conversation to writing, and that in consequence he must be prepared to substantiate his opinions. This he readily consented to, and, therefore, we are now in the position to lay before the Honourable Committee the authentic opinion of Mr. Telford for its further satisfaction, since we can pledge ourselves to the correctness of our questions, and also of his answers, as given above. In submitting the foregoing, we beg to observe that we consider it of the greatest importance to the success of our undertaking, that the opinions of Messrs. Telford and Clark entirely agree as to the two main questions, viz., that the ice will not carry away the piers, and that the piers will cause no serious inundations. Not being yet satisfied, we sought to avail ourselves of the experience of such men as lived in countries where the winter was severe, and where rivers similar to our Danube existed. We, therefore, proceeded to Liverpool, and put ourselves in communication with Mr. Ogden, an experienced mechanician, consul for the United States, at that port. After fully discussing the subject with him in all its bearings, the result of our interview was that a bridge might be built between Buda and Pesth, but that the undertaking would be attended with great difficulties. We therefore drew up a list of questions which we sent to him, requesting his answers in writing; and we have now the pleasure of laying them before the Honourable Committee, verbatim as we received them from him.

Our Questions.

Since the climate of Hungary bears a great resemblance to that of the Northern portion of the United States, and since the natural features of its rivers do not differ much from those of the Danube, what do you consider the most desirable kind of bridge for forming a permanent communication between the cities of Buda and Pesth, the breadth of the river being about 1600 feet?—[*Note:* The reason of our having given 1600 feet as the width of the river was, that the site not having been determined upon, we thought it most advisable to be on the safe side, and assume a larger span. With a less span the difficulty, of course, would not be so great. On the site of the present bridge of boats the width is only 1248 feet.]—Do you not consider that the piers in the river would be much exposed to the force of the ice, and be in danger of being carried away? What amount of experience do the

Americans possess in this respect? Does the experience in America prove that the piers cause a stoppage of the ice, from which extraordinary and dangerous inundations ensue? Which is the longest and most complete bridge on piers in America? Do you believe that iron bridges are much exposed to lightning? And is it true that from this cause such bridges are not adopted in America? What do you consider to be the greatest available span with perfect security? What is the reason that the American bridges in general are constructed of wood, and not of iron?

Mr. Ogden's Reply.

When good timber can be procured cheap and in abundance, I consider that bridges with the superstructure of timber resting on stone piers, with the approaches also of stone, offer more advantages than any other kind of bridge, no matter of what material. A bridge on this principle was constructed about 30 years ago over the river Delaware, at Trenton, and stands to this day in the most perfect state. This bridge was constructed on the suspension principle, with spans of 200 feet each, so that in case of repair being necessary, each piece could be taken out and replaced without interfering with the stability of the bridge. In the spring, when the floods begin to accumulate and the ice to break up, the piers are exposed to great danger, which, up to this time, they have so gallantly withstood, that on this point we have now no fear.—[*Note:* In Mr. Ogden's letter he has described, in complete detail, the construction of the Delaware Bridge, which, however, we have omitted from our report, because we have the honour of laying before the Honourable Company his original letter, together with a drawing of the bridge.] In answer to the *Second, Third,* and *Fourth Questions,* I beg to state that no apprehension need exist of the piers being carried away by the ice, provided they be properly and judiciously constructed of suitable material, such as granite, than which there can be no better. Our American rivers are perhaps more exposed than the Danube to accumulation of ice and inundations; still experience has proved, that, notwithstanding that the piers are strong enough to resist the whole force of the ice, still their section is so small that the ice is not in the least impeded in its course, and in consequence does not occasion inundations. Every one is aware of the great rivers that are to be found in America—perhaps the largest in the world—still I do not think that one can be found over which there does not exist a permanent bridge. I could easily enumerate twenty bridges, all constructed of timber, on different, but still true, principles. For such a river as the Danube, I do not know that I could recommend one better adapted than the Delaware Bridge at Philadelphia. I consider an iron bridge to be quite as secure as any other against lightning, no matter of what material; for by means of a single wire connecting the bridge with the water, the destructive effects of electricity can be obviated. I am not prepared to answer the question, wherein you wish to

know the largest span timber arches admit of; but I believe they can be made equal to those of cast-iron.

The origin of timber bridges in America I attribute wholly to their extraordinary cheapness, which experience has demonstrated; and as they possess every advantage, so we find, even to this day, that out of every hundred bridges erected over large rivers, ninety-nine are constructed with timber superstructures.

And I am of opinion that the more demonstration you seek on this head, the more you will become convinced, that either a suspension bridge, such as is erected over the Menai Strait, or a timber bridge on the American principle, will be the best for accomplishing your object. The latter, however, deserves your best consideration, both by reason of its comparatively trifling cost, and from the advantage of its being free from oscillations, which in several instances have caused the destruction of suspension bridges.

In conclusion, allow me to propose that you might, with much advantage, proceed to America, there to convince yourselves of what has already been accomplished in this respect, where, provided it met with your approbation, you would find engineers willing to accompany you who would undertake the construction of a bridge between Buda and Pesth, and that, too, on the best and most approved principles.

(Signed) FRA. B. OGDEN.

Liverpool, 27th October, 1832.

On the 3rd of November, we again submitted the following questions to Mr. Ogden :—

Who in general finds the capital for the erection of bridges in America—the Government or private companies? If the Government, in what manner is the cost levied on the public? And, if the erection is intrusted to private companies, in what manner do they recover the capital expended? Is not the right usually granted to them of levying toll on all passengers, either for a stipulated number of years, or in perpetuity? And is there any bridge in the United States where no toll is levied? Are bridges in general a profitable investment? How many piers has the Delaware Bridge? what is its entire length? and what was the cost of erection? Do any police regulations exist for providing for the safety of the permanent bridge at Philadelphia, that is to say, for restricting the amount of traffic, which may pass over the bridge at any one time?

To which he gave the following answers :—

"In the United States such bridges as here alluded to are invariably erected by private companies. A right is granted to the company of levying a certain toll on all passengers, in compensation for capital, interest

on the same, and the cost of maintaining the bridge. Besides this, the law undertakes to protect the company against all infringement of its regulations, and gives them the power of enforcing their observance, so that no damage can be done by any one, either intentionally or otherwise; or by heavy burdens or quick driving, without falling under the severest penalties of the law. And since the maintenance of these bridges is always attended with considerable cost and continual repairs (provided that the tolls are such as do not yield an exorbitant profit to the company), it is the custom for the Government to grant the company the right of holding these bridges either in perpetuity or for a long term of years. Bridges over which there is a good traffic are considered good investments; but since the profits are not so much considered as the increased facilities of intercourse, a return of seven per cent. per annum is not considered to be an ample remuneration; and this is about the common rate of dividend to the speculators."

Mr. Ogden also promised to furnish us with several plans of American bridges, as well as to procure for us details of their cost and copies of the laws by which the shareholders were secured; he further, with the greatest politeness, offered us his services in anything he could be of use to us in, and concluded his letters with the following encouraging remark: "That we might rest assured, if we followed the right course, that the genius of our countrymen would at no distant day produce works, of which our country might be justly proud!"

We conferred in Liverpool with several other engineers respecting our scheme; amongst them, Mr. Jesse Hartley, who has a most extensive practice in the construction of cast-iron and stone bridges. Although he fully considered the power of the ice, still he thought that piers properly constructed would resist it with perfect safety. He was of opinion that inundations could occur only if the piers were constructed in the narrowest part of the stream, or if built so close together, and so low, that the inundating water and the floating masses of ice would be so much impeded, that in case the bridge were not carried away, it would act as a dam in penning back the water. Against suspension bridges he spoke with the greatest degree of prejudice, and his views were in part supported by an American engineer in London, with whom we afterwards became acquainted. This engineer was a Mr. L. Wright, a very young, but clever man, who, to our knowledge, had never constructed any work, but

who had completed a very remarkable model of a cast-iron bridge, which we examined with all due attention, and which, as far as we were able to judge, was well designed, on good and simple principles. The opinions of English mechanicians and men of science, however, were very conflicting; for while, amongst others, Messrs. Davis Gilbert, and Mercdith approved of it, the celebrated Stevenson condemned it.

Mr. Hartley considered the oscillation of suspension bridges to be most dangerous, for, as he expressed himself, the least load would put the chains in motion. Owing to this cause he considers a bridge of cast-iron, with arches of 300 feet span, as the only advisable bridge for crossing the Danube at the proposed site. Mr. Wright also condemns the oscillation of suspension bridges: "If they did not oscillate, then," says he, "they would be the most perfect of bridges, for they admit of being constructed of almost any span, while their cost is comparatively trifling; but since their oscillation cannot be wholly avoided, (that is to say, up to this time no effective remedy for it has been invented), I consider them decidedly unsafe." According to his opinion, he should have no hesitation in recommending a cast-iron bridge on the principle of his model, with arches of from 600 to 700 feet span, as the most appropriate. Inundations and the power of the moving ice he did not fear in the least, and in order to avoid all waste of words on this head, he referred us to the numerous American bridges, which had been erected from 40 to 50 years ago, and which now stand in perfect repair, and which have never been found to cause inundations.

Mr. James Walker, one of the most experienced engineers and bridge builders, we had also the pleasure of consulting, but only during the latter part of our stay in England, owing to his extensive practice and engagements: we, however, did not receive a definite opinion from him, but as we had left our plans with him we expected one every moment. From the preliminary conversation we had with him, we think he is likely to give his opinion in favour of a cast-iron bridge (provided our means admit of it), and if not, of a timber bridge. With respect to the security of the piers, he fully concurred with those engineers already alluded to, and he felt convinced that they would not cause inundations if made high enough and at proper distances.

In an engineering point of view, it appears no difficulty exists, and although there is no difference of opinion as to the two principal questions, first as to the possibility of the piers being carried away by the ice, and secondly as to their being the cause of serious inundations; still, both English and American engineers were quite decided as to the kind of bridge they would recommend. In all that relates to the two principal questions above mentioned, we fully concur; for if we examine only for a moment the principle of construction of our own existing bridges at Dresden, Prague, Lintz, Wiener Tabor, and Esseg, it is impossible not to feel convinced that a bridge may also be erected between Buda and Pesth with one, two, or three piers, each from 24 to 30 feet thick, without any fear of causing an inundation. The bridges at Dresden, Prague, and Lintz, during high floods are no better than dams, their piers are so low and so close together that they barely afford room for the ice and water to flow through, and, notwithstanding, it rarely happens that they are either carried away, or that they cause inundations; their construction is, however, extremely faulty, while their great disproportionate strength, or rather too great thickness, is, in fact, their weakness, for since the water way is so much confined, in floods they have to bear the whole weight both of the water and ice. The bridge at Dresden, as is well known, has stood uninjured for a long series of years; on the other hand, not many years since, the bridge at Lintz suffered considerable damage, and if we are not mistaken, some of its arches were blown up by the force of the ice. Is it then to be wondered at, or rather, we should say, is it not perfectly natural, that many "bridges" called "good" should have been destroyed by floods and ice, over rivers which, in point of magnitude, are not worthy of comparison with the Danube? though it has given rise to such sayings as: "Because that insignificant stream has destroyed such a good and stable bridge, which appeared to bid defiance to centuries, it is therefore impossible to build a bridge over the Danube, which is a hundred times more powerful."

Let us, however, investigate of what kind this "good bridge" really was, and we shall find that it was, in fact, nothing more nor less than a pile of stones, some large and some small, heaped together without judgment, while the arches were so low and

badly constructed, that in the direct proportion as the water and ice increased, so did the obstruction. The consequence of having the piers low is, that the moment the water begins to rise and has reached the springing of the arch, the passage way decreases; and, thus, when the freest passage to the ice and water is required, the least is afforded, and the result is often similar to that which took place with the bridge at Lintz, where the ice, collecting under the low arches, and so impeding the flow of the increasing waters, blew them up, with a force inversely to that which would be required to break them in from above. Hence the general phrase, "It is impossible to build a bridge across the Danube," has become a password. According to this old-fashioned and faulty plan, the old London bridge was built, which at high water served as an actual dam in the proportion of 80 to a 100, while the opening or free passage for the water was as 20 to a 100. Again, the Wiener Tabor bridge —on what principle was it constructed? single piles were driven into the bed of the river with the most unwieldy and clumsy machines, the piles having often to be spliced together in order to reach the bottom, which had been washed out by the scouring action of the water, and notwithstanding the most indifferent workmanship, that feeble structure has lasted many years.

The bridge at Esseg is another example of this kind: it is built of timber, with the piers 78 feet only apart, and although a most serious impediment to the flow of the ice, it has now stood nine years without having suffered any damage worth notice. Let us now suppose, for example, that between the section *A B* and *b a* five piers, each 24 feet thick, and of such a height that during the greatest floods the surface exposed to the water shall not exceed 24 feet, be constructed; the width of the river at this point will then be diminished 120 feet, and if the width of the river be taken as equal to 1560 feet, we shall then have a clear water way of 1440 feet remaining; on these piers we can either erect a suspension bridge, or have arches of timber or cast-iron as we please. The span being only 240 feet, the oscillation in such a suspension bridge would be almost imperceptible, but, as is manifest, the whole quantity of the ice and water must pass through the section *C D*, which is only 1020 feet; we shall therefore have a water way on the site of the

proposed bridge at *A B* and *b a* 420 feet greatcr than that at *C D*.

Let us next compare our solid, lofty, and well-constructed piers, with the disproportioned, thick, and stumpy supports of the Dresden, Prague, and Lintz bridges, or with the trembling, straggling supports of the Wiener Tabor and Esseg bridges. Then, if we bear in mind that the bridges at Dresden and Prague, with all their faults, have stood many centuries uninjured, and that the bridges at Lintz and Wiener Tabor have defied the ice and resisted its power, and then combine all these results, we shall be able to say with certainty that there is not a single insurmountable physical difficulty opposed to our ardent wish of uniting the two cities of Buda and Pesth by means of a permanent bridge.

Now, although the Danubc at Pesth is indisputably broader and more powerful than the Danube at Vicnna or Lintz, the Elbe at Dresden, the Moldau at Prague, or the Drave at Esseg, still water and ice must be subject to the same laws under nearly the same climate; and, as the engineers of the present day are one hundred times more skilled than those who constructed the bridges at Dresden and Prague, it follows of course, that if these piers have stood uninjured to this day, surely men of far greater experience can erect piers between Buda and Pesth which shall bid defiance to the mighty Danube; yes, and to far mightier rivers too! We shall now proceed to review the consequences attendant on carrying out our suggestions: at that point where we purpose to construct a bridge, as at section *A B*, *b a*, first we have proposed a bridge with five piers, each 24 feet thick on the highest water line, and which will be equal to a contraction of the width of the river of 120 fect. Now it may be apprehended that this diminution of 120 feet will cause frequent inundations, and if so, we bcg to suggest the simple remedy of a less number of piers, for instance, only four, which will cause a diminution in thc width of 96 fcet only; this, however, is not sufficient to allay all fears, so wc must bcg to recommend the adoption of Mr. Tierney Clark's third design, where only one pier is proposcd, which will cause a diminution of 42 feet only in thc width of thc rivcr. Let us hcre pause a moment and ask thc qucstion whether it is probable any one will be found bold enough to stand forward and assert that cven this single pier

will cause obstruction enough to lay the adjacent cities under water. No, we do not consider it possible; for on what principle can it be demonstrated that the ice, instead of flowing on through an unimpeded channel, should turn aside and pertinaciously adhere to this single pier?

Gentlemen, the very notion of such a thing is perfectly absurd. From this we may justly conclude, that, supposing a bridge with six arches to be objectionable, a bridge with two arches or with one pier only need not be so; and as no engineering difficulty is attached to the construction of a suspension bridge with one centre pier, we again come to the possibility of uniting the two cities. The important question now remaining to be decided is, what kind of bridge is best adapted, both with regard to our financial resources and the nature of the Danube: with regard to this object we beg leave to lay our humble opinion before the Honourable Committee, which we beg may in no way be considered as anticipating their decision; but from the fact that having devoted the whole of our time for many months to the consideration of this point, and having investigated and well considered the advantages likely to arise from the adoption of any of the existing examples, we think ourselves called upon to lay our unbiassed opinion before the Honourable Committee.

First, with regard to a bridge with stone arches, we consider the idea must be abandoned; for supposing we possessed the enormous sum necessary for such a work, it would not be applicable to the river, on account of the great number of piers required; and the limited height, owing to the lowness of the shores, would inevitably produce the most serious inundations. The largest stone arch to our knowledge is to be found at Chester, in the bridge which spans the river Dee—the arch is 200 feet span. The celebrated Rialto bridge at Venice has a span of only 90 feet. Now since the Danube at the section, *A B*, *b a*, is 1560 feet, if the span of the Chester bridge be adopted here, we should require six massive piers in the river, and the bridge would in consequence be raised too much, so that the approaches would nearly equal the whole length of the bridge, and owing to the locality could not be accomplished.

Before proceeding further, we must beg to assure our countrymen, that we are of unanimous opinion that no bridge which does

not at present exist, and which has not been fully proved by trial, ought to be recommended: were it otherwise, our time and money might be lost in experiments, which, if not attended with success, would have the double evil of retarding our advancing steps. We find that in a model many things are considered perfect which when carried out on a larger scale do not succeed; we therefore consider the best and most sensible plan for us is to follow and study closely the result of practice only, so that, instead of trying experiments for others' benefit, we may rather profit by past experience; and therefore we do not see that we can in justice to our subject recommend stone arches of 200 feet span, since we are not aware of the existence of another example of the kind. The centre arch of the new London Bridge is only 150 feet span, and the nine arches of the Waterloo Bridge are only 120 feet each in span; the latter, however, was considered by Canova, during his stay in England, as the greatest master-work he had seen, which for its beauty of proportion and symmetry exceeded all others ever built.

Secondly, with regard to cast-iron arches, we consider them much better adapted to the Danube, for it is not only demonstrated beyond a doubt, but practice proves it, that they may with safety be used in spans from 240—300 feet, and we cannot find a better example than the centre arch of the Southwark Bridge, which has a span of 240 feet; if, therefore, it were necessary, from four to five piers might be constructed in the river, where it is from 1320 to 1560 feet wide, without, as already stated, occasioning any inundations, as experience in America has fully proved.

Thirdly, with reference to suspension bridges, prejudice, and a natural dislike to them, are so strong, that it requires time to overcome both. The astounding appearance of the structure—the ideal and airy form in which it presents itself, tend (if we may so express ourselves) to overwhelm the senses, and to deprive man of his judgment; and it is not without much pleasure we acknowledge that our fellow-men have accomplished things we can with difficulty form any idea of. We had never seen such a structure; and we must acknowledge that our first impression on beholding it was but the reality of what we have here endeavoured to delineate. If surveyed from the side, and from a distance, it appears like the finest filagree work, and it is impossible to convince oneself of its

stability—we were particularly impressed with this feeling as we approached the Menai Bridge from Bangor, and beheld it, as it were, suspended in the air : we, however, soon found ourselves upon it, and surveyed with wonder the gigantic chains by which it was supported. In general the first impression that we received on beholding a suspension bridge was anything but agreeable—our eye and judgment, already well practised in determining the proportions of wood and stone, could with difficulty be brought to appreciate the disproportion of the iron, which from the strength of that material is small in quantity, and gives an appearance of weakness to the structure.

This feeling was particularly excited on inspecting such works in England; for instance, the interior of Covent Garden and Drury Lane Theatres. It is, therefore, not to be wondered at, if, at first sight, suspension bridges raised in us a feeling of doubt, for compared with other buildings in iron they appear much weaker, since the whole, if we except the piers and the platform, are wholly of iron, without any covering, and generally at a great elevation. Before our journey to England, we must freely admit that our prejudice against suspension bridges was very great, and we considered them as only available where the traffic was small, and consisted chiefly of foot passengers, who are more easily kept in something like order. The force of the wind excited also the most lively apprehensions, so that we considered it altogether as impracticable, to erect a suspension bridge, even with two or three spans, between Buda and Pesth, without, at the same time, having before our eyes the most frightful oscillations, and its total destruction. Now, however, that our eyes have become accustomed to judge of the proportions of iron structures, and that we have ascertained, with most extraordinary accuracy, how the smallest part of an iron bridge is prepared, and its great strength, and have seen numbers which have stood for many years without the slightest injury, and have beheld the traffic which daily and hourly passes over them, we are of a different opinion ; we now consider them so secure, provided they are constructed as they ought to be, that if all we possessed—if even the prosperity and hopes of our Fatherland depended upon their safety—we should not have the least fear. As regards the force of the wind, we cannot but laugh at the groundless fears which our inexperience

had excited; we do not now consider that there is the least cause for such apprehensions: on the contrary, the construction of a suspension bridge is such that the surface exposed to the action of the wind is so small in comparison to its strength, that we consider any other structure much more exposed and liable to injury from the force of the wind. It is, however, well known that until within the last few years suspension bridges were in their infancy; and that the experience of the present day far exceeds that of a few years back, and in consequence we consider that those bridges erected on the Continent of France—especially at Paris—cannot be referred to as examples; and further, we should consider any person who would judge of those constructions from such examples, to be incapable of giving an opinion.

Fourthly, with respect to bridges with timber superstructures we can only speak theoretically, not having seen a single example which would be suitable to our locality. The experience of the United States, however, removes all doubt as to the possibility of constructing a timber bridge on stone piers between Buda and Pesth, for there are many existing bridges in America with spans varying from 200 to 250 feet.

From the foregoing, we arrive at the conclusion that three kinds of bridges admit of being constructed between Buda and Pesth with more or less facility; for we find both cast-iron and timber bridges, as well as suspension bridges, well adapted. As to which of these three kinds of bridges would be the most advisable under the existing circumstances, we beg to be allowed to lay before you our observations on that point.

Cast-iron bridges have not the least oscillation; and, to all appearances, are capable of defying time;—however, the largest span they admit of (that is, unless we wish to experimentalise) is from 200 to 300 feet; while, on account of the great thrust of the arches, the piers must be very massive; and in consequence would oppose more resistance to the flow of water than either a chain or timber bridge, which admits of larger spans with less massive piers. If the arches be very wide, and be constructed according to the circumstances of the locality; as, for instance, in our case; the arches, and consequently the approaches, must be very high and very long, which with reference to the Buda side should be carefully considered. The cost, too, of such a bridge may be taken at double

that of a suspension bridge, and most likely at four times that of a timber bridge.

Suspension bridges possess two great advantages, as compared with all others: First, they offer a far less resistance to the passage of the water and ice, because they admit of the largest span; and because the piers, upon which the whole load acts vertically, can be made small in proportion. Secondly, they require much lower approaches than all other bridges. This point deserves particular attention, when the magnitude of our river, the immense force of the ice, and the lowness of the banks are considered. Oscillation, on the other hand, cannot be avoided; and its effect upon large spans would perhaps require to be controlled in some manner, in order to prevent danger from inordinate loading, and the passage of vast numbers of persons on foot over it at the same time; this latter being the severest trial which can be applied to a suspension bridge. Besides, the greatest amount of cleanliness and supervision is necessary, since iron, when exposed to the action of the atmosphere, readily oxidises. This, in our climate, however, does not take place to the same extent as in others, where the atmosphere is more moist, and where, of course, iron is more rapidly acted upon. Lastly, bridges with timber superstructures are the cheapest of all permanent bridges; their duration without continual repairs is, however, short, and according to our opinions, or more properly according to our tastes, we consider they would not be approved of: they are constructed on the suspension principle, and require to be covered over, which prevents their being made use of as a promenade, for fresh air and exercise. The most appropriate site for the proposed bridge is the next consideration, and depends upon many circumstances, which require to be well understood (at least better than by us), before an opinion can be risked; we are, however, of the opinion that it would be by no means advisable to erect a bridge at the narrow part of the river between the Block's-bad and the point opposite, where one pier would be dangerous, since not one engineer in England recommends the adoption of a bridge of one span.

On the site of the present Bridge of Boats, a bridge could not be constructed without a considerable expenditure, because the banks are at this point very low, and as a bridge would require its approaches to be from 18 to 20 feet high, much ground would

be necessary, which, owing to the number of well-built houses here abouts, could not be obtained without considerable cost. Here, then, with regard to the mechanical part of our undertaking, we beg to close our Report. We have laid before you the opinions of several engineers, and have taken the liberty of adding our own; but as the most competent judges are not always of the same opinion, we have not ventured to do more than lay before you, in as faithful a manner as possible, the nature of the various bridges with their advantages and disadvantages as estimated by us.

Having, during the course of our travels, occupied ourselves in devising means for the carrying out of our undertaking, we must beg again to be allowed to trespass on the patience of the Honourable Committee, while we lay before them a few of our observations on this head.

Any one of the three bridges already described is practicable, if means can be devised for raising the necessary capital; from which it is evident the success of our project depends upon our financial resources.

According to Mr. Clark's computations, as already observed, the cost of a suspension bridge would barely exceed 120,000*l.*, the cost of a cast-iron bridge would be near upon 240,000*l.*, while a timber bridge would possibly not cost 60,000*l.* Without more accurate calculations, it is, however, impossible to determine this with any great degree of accuracy; it is impossible to furnish accurate estimates without a previous knowledge of the locality. As, however, it is not our intention to anticipate the decision of the Honourable Committee on the point, as to what kind of bridge is best adapted, feeling confident that they will lay this important point before our Diet for their decision, we shall proceed to consider the best manner of raising the necessary capital only, and for that purpose we shall assume that a permanent bridge can be erected between Buda and Pesth for the sum of 200,000*l.* If, now, the actual cost should be either less or more than this assumed sum, we consider it of little importance, since we are of opinion, that the success of the undertaking does not entirely depend on the accuracy of the estimates; on the contrary, we consider that it depends in a much greater degree on the good or bad choice of the sources from which the capital is to be drawn.

The practicability of raising 200,000*l.* in a country like Hungary,

no one can doubt, who has any knowledge of our resources. We shall, therefore, take the opportunity of pointing out to the honourable Committee the various ways in which it can be done.

First.—The sum named may be so apportioned to every inhabitant of the land, without distinction, as to leave the burden alike upon all, and oppressive to none. When the bridge is finished, every one may have the free use of it without toll. The kind of bridge we propose to build will cost but little in annual repair, and this may easily be paid by the State. Our object will be thus attained; the two cities become one, and the two portions of our territory separated by the Danube permanently united.

Whether the imposition of a new, though trifling burden, might not perhaps weigh too heavily on those who now pay taxes, and lead to others, is a question of itself. We frankly confess, that such a measure is hardly in accordance with the spirit of the times or the duties of the present Diet, whose object should be rather to alleviate than to impose burdens.

Secondly.—The nobility might take upon itself the whole charge of providing the 2,000,000 florins. This sum, exclusive of the cost of maintaining the bridge, which the nobility must also bear, would amount to little more than nine times the value of the "Coronation present;" and if spread over four or five years, (the time it would require to finish the work,) would not impose upon us a greater annual charge than twice the amount of the "Coronation present." We should thus complete our bridge; every one would have the free use of it; and the nobility, with the proud satisfaction of having themselves only to thank for that noble work, establish a new claim to the gratitude of their country. This would give strength to the aristocratic element in our constitution, and recall the early period of our history, when the nobility contributed more to their country's service than the people.

But this mode of proceeding has its objections. It supposes us, as it were, going back to old times, and forgetful of the measures necessary to our present condition, entering as we are upon the summer of our national existence.

For example, let us take the case of a nobleman living on the other side of the Danube, and unable, from his advanced age, to leave home. He is subjected to an annual call of 20 florins for five years. Would not he with justice exclaim, "I never leave my

house; I don't even go to Pesth to look after my law processes, for whether I go or not, if I am in the right, I gain, and if in the wrong, I lose; my corn I send to Kanizsa, my wool to Odenburg; the Pesth bridge is of no use to me. Upon what principle of liberty am I to pay 100 florins towards an object from which I derive not the slightest advantage?—I, indeed, who from the badness of the roads can scarcely reach the nearest market." What answer can we give him? "Will you enjoy all the blessings of our common country, and contribute nothing to her. Do you not see the vigour that it would impart to Hungary, the strength it would give to the Crown, to unite by a permanent passage-way across the Danube the disjointed parts of Buda Pesth and our land; how it would, by stimulating our nationality, lead to the development of all that is useful and great?"

We hardly think this answer would be sufficient; and therefore are forced altogether to reject this second mode of proceeding, viz., throwing the whole cost of the bridge upon the nobility.

The objection to the above plan is less striking in single instances, than it becomes when many such undertakings as the Pesth bridge are under consideration. We firmly believe, indeed we are fully convinced by the living testimony of other nations, that one patriotic undertaking leads to many others, and gives an irresistible impulse to a general spirit of improvement. In this way we may look forward to the regulation of the Danube, and to connecting it and other rivers with the sea; to the construction of a railway on the Louisen-strasse; to the draining of our marshes; intersecting our country with canals; throwing bridges over all our rivers; and converting Pesth into a port, which, by means of a canal communication with the Theiss, the largest steam-boats from Tokay, Semlin, Essek, Sisek, Vienna, and even Constantinople, may reach without difficulty or delay. But how is all this to be brought about? Ever and anon by voluntary offerings (*libera oblata*).

What, then, would our good old gentleman on the other side of the Danube say, were we to knock at his door twenty times a year for similar purposes? For the glory of our country, 20 florins for a bridge at Szegedin; for a Komâder canal, 30 florins; to give an impulse to our country's trade, 10 florins for a railway to Raab; and so on, *ad infinitum*. And, further, were we to include the

cost of maintaining these works, &c., would not then the good old gentleman above mentioned become more dissatisfied as our country grew prosperous and enterprising, and at last take to flight, to get away from voluntary offerings and a free country?

Desirous as we all are, worthy Committee, to be useful to our country, shall we be satisfied, if, in effecting the construction of one bridge, we do not at the same time prepare a moral bridge to lead us to the accomplishment of other similar objects? and shall we believe that our fellow-citizens, after building one bridge, will remain for centuries indolent and listless, ere they project any other undertaking? No, worthy Committee, this voluntary system, this *liberum oblatum*, is ill suited to our manly age. Some may, indeed, advocate it, who regard our prognostications of our country's prosperity as idle dreams; we ourselves think differently, and regard the *liberum oblatum* as a feeble lever to operate with in times like the present. We believe that we shall be doing a far greater service to our country than the erection of one or even ten bridges would be if we strive incessantly and with all our energy to carry out a system which, natural and simple, has been found to work well in other countries, and which, if adopted, would be of the same advantage to our own. Following out this system, in consequence of the tendency of the age to occupy itself with useful projects, we shall have the good fortune, not only to accomplish a vast deal by pick and spade, but we shall be able to do, what is equally advantageous, employ the active and restless spirits of the day, and economise time, which is the greatest of treasures.

This better system, which we recommend, is an issue of shares. We shall avoid by it pressure upon contributors, and the disagreeableness of finding out some plan, by which we can equally distribute among the inhabitants of the land without exception, the costs of erecting and maintaining the bridge, without warring against principle, or losing ourselves in theory. The injustice of compelling men to pay for what they do not use will be done away with, and the inconveniences, to call them by no worse a name, attendant on the collecting of voluntary offerings, avoided, as well as those anomalies, which, in the present enlightened century, do us Hungarians no honour.

Shares, however, will not be issued to produce loss, as, with few exceptions, every body will gain by them.

The present bridge of boats between Ofen and Pesth, which is used upon an average nine months in the year, yields, according to the data collected last spring, an annual income of 40,000 florins, and would, according to the calculations then made, yield 100,000 florins, supposing it to stand throughout the year, and all persons passing over it to pay the present rate of toll.

Now, however, were the permanent bridge to cost 2,000,000 florins, as we have assumed, neither the 40,000 florins nor the 100,000 florins income would suffice to induce shareholders to embark in the undertaking. It would require at least 160,000 florins income—120,000 for a 6 per cent. dividend, 40,000 to uphold the bridge.

With respect to the last expense, according to the answers of Messrs. Telford and Clark, it would seem that we have estimated it too high. We must bear in mind, however, that in England every one but Royalty pays toll—that the tolls are taken in a simple and inexpensive manner, and few persons required either for that purpose or to look after the bridge; that cleanliness is maintained by persons who consider themselves compensated by the sweepings of the bridge, and so costs nothing. All this is very different with us, and therefore we prefer putting the above charges too high rather than too low.

The next question is—How are we to get the 160,000 florins income? By quadrupling the present tariff to those who now pay? Possibly: but then we risk diverting men, merchandise, &c., into another road, as, for example, the one by Földvar or Waitzen; but were this not to happen, can anything be more unwise than to saddle an already sluggish and inanimate commerce with an additional load, and so impose upon our payers of taxes a new and onerous burden.

A tolerable bridge, and one suited to our requirements, will scarcely cost less than 2,000,000 florins, whence it follows, either that we must have no bridge at all, because a particular mode of obtaining the funds is unconstitutional, or we must all be compelled to pay toll alike.

As to the impossibility of establishing a general toll, from its being at variance with our constitution, we have no hesitation in saying that the whole difficulty arises from a misconception of the

true spirit of the constitution. If its principles are to exclude every, even the smallest, improvement, and not allow us to unite our two cities by a bridge, when the project is to be carried out by means of shares, but compels us, by disproportionate burdens on the people, to attain our object; or to trust to the contributions of some hundred noblemen or so, in order that a few may be exempt from toll; or, otherwise, that the many who remain at home, and never use a thing, shall pay for the few who enjoy the full benefit of it: what is this, but a mockery of liberty?

Had our constitution depended for its stability on such wrong-headed notions as these, it never would have lasted so long, or had fate hitherto preserved it as a phenomenon, in the present day it would have instantaneously perished. Of this we have no fear. We maintain that the erection of the noblest national monument, by means of shares, is in perfect keeping with its true philosophic spirit. Prejudices in direct opposition to this have prevented us accomplishing any one great thing. It is quite impossible to construct and sustain great undertakings in the two ways above mentioned, of which fact our country affords us sad proof, in not having one single work of public importance to show. The error lies, not in our constitution, but in the wrong notions entertained of our constitution, and these keep our country in bonds. Further, we beg to ask, how it can be considered contrary to the spirit of our constitution, if on any day of the meeting of the Diet, of our own free will and common consent—in short, under no restraint whatever—we pass a law of exception, that for a definite time, every person, without distinction, noble or otherwise, shall pay a certain toll to be fixed by the Diet, in passing over the new bridge between Buda and Pesth: but we shall by and by refer to this subject. We ask now, how can our liberty be encroached upon by such a law? would a constitution be called free which was averse to such a law? would it merit our support? Could the Hungarian respect a law-book, wherein was written, "Thou shalt not build a bridge by means of shares; Thou shalt not improve the navigation of the Danube?" that is, "for the strict upholding of thy liberty, thou must remain where thou art, and never deviate from thine old ways;" still more, "Thou shalt not alter or amend that law, which to thy greatest injury excludes thee from the payment of toll, for the purpose of promoting national undertakings."

Here, as everywhere, the multitude is led into error from its inability to make proper distinctions. Were the government without any previous law to build a bridge and impose a toll, however small, we might have our fears and anxieties; we had rather, perhaps be deprived of any bridge in future, and pass the river in boats, even in winter, however inconvenient it might be, than pay for a bridge built by any but ourselves. The ice would be preferable to a tax imposed by a foreign hand, which being arbitrarily imposed, might, we fear, become intolerably oppressive, so that the "nothing" would be far better. But let us ourselves name the burden, and the Diet regulate the tariff for the future—what danger can we then apprehend? Can resolutions of the Diet, which concern our internal welfare, at all alarm us? Those laws and ordinances, which impose equal burdens, and, for a limited time only, upon the inhabitants of a land, are the surest triumphs of liberty, and evince the true vitality of a nation. It is a *sine quâ non* that all share the burden alike, or otherwise we shall fall into the unavoidable dilemma either of pressing too severely on one particular class, or of abstaining from a great national undertaking, because of its incompatibility with our notions of liberty. This error is the cause why we Hungarians, in perversely adhering to our independence, have no other than frail and perishable monuments to show. Were each person, however, to share the burden of the work, which the nation contemplates, no one would feel it more than another, and there would be no undertaking hereafter that we might not project, and successfully carry out. Laws, which aim at nothing but the national welfare and the national glory, can never be thought oppressive by any true patriot, provided they are enacted for a definite time only, *i.e.*, in the present case, provided the payment of toll is to cease in a certain number of years. Now, unless a profit can be shown, no shares will be disposed of. If, in future, those only are to pay toll who now pay it, the shareholders will gain nothing, nay, rather, they will lose, for a fixed bridge will not cost less than 2,000,000 florins. We shall then find ourselves reduced to the painful dilemma either of increasing the toll four or five fold to its present payers, or of having no good and permanent bridge. Thus, from our mistaken notions of liberty, we shall in future have to contend with water and ice, transport ourselves and wagons in sledges over

the ice, and submit to numerous other inconveniences—a pretty caricature of liberty!!

The hope, which many entertain, that the shares will easily be disposed of, though offering only two or three per cent. interest, is a pure delusion, and entirely nullified by the incontestable evidence of figures.

Suppose the bridge to cost 2,000,000 florins, keeping it up, 40,000 florins, rate of toll as at present, there will remain for payment of interest on 2,000,000 florins the income of the three winter months, during which the bridge of boats is removed. This income we estimate at 20,000 florins; hence, instead of two or three per cent., the shareholders will scarcely get one per cent., and there will not remain a kreutzer for a sinking fund. For such a speculation we do not believe we shall get 2,000,000 florins. No one—least of all, we Hungarians—can afford to throw away such large sums, needing them, as we do, for so many other purposes. Let us build our bridge "by shares!" "by shares!" as many cry out; but this is not the true bearing of the case; the compelling our nobility to pay toll is the real point.

"We must build a good bridge cheaper, then," exclaim persons. We are not of that opinion. The English and the Americans have never yet found out how to combine cheapness with goodness in the construction of their bridges. Whether we, with our scanty means and small experience, shall be more fortunate in effecting this desideratum than those who have had the multiplied experience of some hundreds of bridges, which now stand, and firmly stand, is a question we are not prepared to decide; but this we say, that in our judgment, we shall act far more prudently in making up our minds at once to an outlay of 2,000,000 florins, than in spending as much, or probably more, in experiments: for in the one case we shall undoubtedly have a good and useful thing for our money; and in the other, most likely fail in our experiments, and lose both money and time.

The whole matter reduces itself to a question, whether the country will rest satisfied with its present communication between Ofen and Pesth or not. If satisfied, the present mode of meeting the expenses of the bridge is perhaps suitable enough, and things may remain as they are; if not satisfied, a greater number of

participators in the expense than now will be required. Without contradiction and manifest anomaly, there is no mean betwcen these two alternatives. Whcrc are we to look for these additional participators, but in our own country? We ought therefore to encourage that principle of justice which teaches us to take on our own body new and great burdens, for new and great objects, proposed and carried of our own free will and common consent. This principle is not only in accordance with the true spirit of our constitution, but, in proportion to its development, the surest and firmest foundation of true liberty. The recognition and application of this principle is not only a *conditio sine quâ non* towards the erection of a more expensive bridge, but also towards putting beyond doubt the practicability of any undertaking that shows a profit. Were we to succeed in building our bridge as we propose, and were it to return less interest than we anticipate, the principle once established, we should have no difficulty in applying it. In a few years, in a country like ours, capable of so much improvement, we should see such great and stupendous works carried into effect as would surprise and astonish even those who now look sanguinely to the future. Of this, we have a striking example in America—a thinly-populated country—where a hundred times more has been done in one century, than in Hungary during a thousand years.

Let us return to our bridge. We come to the conclusion, that we must adopt one or other of the plans mentioned, or have recourse to thc share system, and compel every one, without exception, to pay toll. The toll must be increased, in order that the income of the bridge may meet the interest required, the cost of upholding it, and leave a sufficient sum to establish a sinking fund for the gradual repayment of capital, and for throwing open the bridgc to the public, after a ccrtain period, toll free.

We think we have sufficiently shown the inappropriateness and objectionable nature of the first and sccond schemes, and hope our third proposal will meet with favour and support; since the greater number of our fellow-citizens are prepared to take upon themselves "for new and great convcnicnccs, ncw and greater burdens." The success of uscful undertakings must of necessity follow, when the greater number are agreed as to the manner in which the burdens are to be sharcd. Thesc, if imposed in the two ways previously mentioned, would be repulsivc, unjust and complicated; whereas,

if imposed in the third way, they would be just, natural, and simple.

We must either renounce our bridge and every other great undertaking, or pay toll of some kind for a definite period. The payment of toll is however so detested among us, that we scarcely hope to triumph over the prejudice against it ; but let us try. In what this horror of toll-paying originates we will not inquire, as it would carry us beyond the limits of our report. England and the United States, where freemen dwell, and pay self-imposed tolls, are sufficient for our example. May we ask, why the temporary payment of bridge-toll deserves such opposition, that we must forego all the advantages which the connecting our two cities would confer upon the whole land and our national existence. Let us now be allowed to show the practical part of the matter, *i.e.*, the little difficulty with which the mechanism of toll-taking can be conducted.

First of all, the tariff of our bridge must be so arranged and established by the Diet, that the probable income may amount to 200,000 florins. This sum may, according to our calculations, be obtained by raising the existing tariff to "Convention's money," and making every one, without exception, pay toll.

In this way 5 per cent. interest will be covered by 100,000 florins, the cost of keeping up the bridge by 40,000 florins, and a clear 60,000 florins remain the first year for redemption of shares. In proportion to the increase of this last sum, the fundamental capital will decrease ; a less and less sum for interest will be required, and more shares constantly paid off, so that in about 20 years the bridge will have paid itself, and may be thrown open toll free to every one, leaving an annual charge of 20,000 florins to sustain the bridge and keep it in good repair. This sum may be obtained in various ways : by charging a certain toll for horned beasts, putting a window-tax on all householders of the two cities, or perhaps by allowing the payment of toll to last for 25 instead of 20 years. This last expedient would yield a clear sum of 800,000 florins, thus constituting a capital for the 40,000 florins which will be required for keeping up the bridge.

To avoid the inconvenience of always putting one's hand in one's pocket to pull out a silver kreutzer to pay the toll, subscriptions for a certain time might be allowed ; and thus the necessity

obviated of presenting a ticket. The toll-takers would soon know the subscribers. If we compare with this all the disagreeables we have in winter to submit to, we believe no one can make any reasonable objection to the payment of bridge-toll, especially when either the "this or that" occurs to him, upon which the whole matter turns, viz., that a bridge is impossible unless every one pays.

But notwithstanding all the advantages which attach to the third plan, we must confess to the Committee, with the same frankness that the Committee itself owes to the country, that, in our opinion, the success of the bridge will not be assured by a creation of shares, although every one without exception is made to pay an increased toll. The entire affair must be intrusted to a Company, which must have the right of levying a certain toll upon every one who passes over the bridge, and be protected by the state against every possible damage and injury.

Further, if we take for granted that the Diet passes a law, for a limited number of years, to subject every one, without exception, that uses the bridge to pay the toll, and grants the Company which it takes under its protection, the requisite privileges, shall we consider our triumph complete? By no means; for the Company must first appropriate its 20,000 shares, *i.e.*, obtain its 2,000,000 florins. This is a great difficulty, which it is better to remove at once than, after much trouble and contention, gain a point and subsequently abandon it. Two million florins is a large sum of money; it is required, however, for our 20,000 shares; but where and how shall we dispose of them? In Hungary it is difficult to believe; we may succeed, indeed, to the extent of a few thousand florins, but where are the 2,000,000 to come from? Perhaps they may be taken on the Continent. Our credit, however, abroad stands very low. Perhaps they may be taken in England? Not at all likely; bridges there have been such bad speculations that nobody would touch them. This is no argument, however, against our bridge, because English bridges are so numerous, and have been constructed at so great an expense, that they yield no more than one or two per cent. profit.

In England the dividend is less regarded than the usefulness and advantage of safe and permanent communications. Several bridges, as the Waterloo, Southwark, &c., have comparatively little traffic, and return scarcely any profit, and may be considered as

mere objects of which the nation may be justly proud. In England probably not one of our shares will be taken, although our bridge may be considered in quite a different light to any other, being the leading point of communication for the whole country, as well as for the two main cities. Nor will its income be precarious, but absolutely certain; so certain, that we know of no safer investment for money, either in an industrial or mechanical point of view, than the shares of the Pesth and Ofen bridge.

But perhaps this is our conviction only, or that of few, and not enough to secure success to our undertaking; for although we few are willing to contribute according to our means, our contributions would barely pay the interest on the 2,000,000 florins, whatever might be our inclination. The magnitude of the sum demands the co-operation of large capitalists, few of whom are to be found amongst us, and enough has been said to disabuse us of reliance on foreign countries.

Besides all this, one circumstance, which makes us doubt whether 2,000,000 florins can be realised for a Pesth and Ofen bridge, must not be overlooked. It is a general rule, that the rate of interest rises or falls in exact proportion to the soundness or unsoundness of the security. Let the public, or those who possess the 2,000,000, once be convinced of this, and the building of our bridge is certain. We cannot conceal from ourselves the little confidence the public has in a work like the Pesth bridge to stake its money in it at five per cent. However, this may in some measure be remedied when we consider the nature of interest. The shares, it is clear, will only be taken by those that like them. Now, if there be any law limiting the rate of interest, nobody will take one. If, however, the interest is left to itself, instead of 5 per cent., the shares will bear 6 or 7 per cent.; and as the annual drawings proceed, instead of the shares selling for 100 florins only, they may bring 120 florins, perhaps 150 florins. The whole affair would thus wear another aspect, and many, attracted by the safe interest and possible gain of 20 or 50 per cent., would invest a portion of their capital in our bridge. But, honourable Committee, speaking frankly, is not all this extremely problematical? and should we discharge our duties as we ought, were we to persuade our countrymen into an undertaking of whose practicability we were doubtful? the more so that we, the representatives of our

country, after repeated discussions and entire publicity, had passed a law which could have no good result. Could we ever forgive ourselves for having so compromised our country? and would it not have been far better not to have agitated a matter that could only mislead and embarrass us, and could not be carried out? Although we agree with many in respect to the money part of the business, who, with cash at their command, are as competent judges in their way, though not more so, than Messrs. Telford and Clark of the mechanical part of the business; and although we are assured by them that money enough may be found, and the Pesth bridge built by shares in the manner proposed, we consider it only probable, but not certain. One may reason much on such matters, and there are not wanting persons who, easily lending themselves to delusions, become at once silent and cautious, and draw back immediately—it is a question of deeds, and not of words. We, however, are responsible, and must struggle for success; and therefore, honourable Committee, since for other enterprises, such as canals, steamboats, &c., which have a sure foundation, and inspire the public with more confidence, we hold the system of creating capital by shares to be all-powerful, we prefer this way of building a bridge. Though it is not an undertaking which enjoys general favour, in our opinion it is the surest method, and so certain to succeed, that we shall not risk the reputation of the Committee, nor compromise the representatives of our country, nor disappoint the general expectation, but, by God's help, we will greet the four quarters of the land with a permanent Pesth and Ofen bridge.

This method is so safe and simple, when properly understood, that it cannot fail to meet with general approval. It is the same by which the United States, in spite of its surprising extent of territory and small population, has achieved works that appear as phenomena hitherto unknown, excite the astonishment of the world, and never could have been produced in such perfection and in such numbers if the system had not been sound and good—a system which constitutes the soul of industrial, mercantile, and political enterprise, viz., the Bank system.

Thus, as far as money is concerned, your honourable Committee will find no difficulty in the construction of a bridge. Let us examine the matter.

We have already said that a permanent bridge between Pesth and Ofen will produce an annual income of 200,000 florins, if every one without exception were to pay a toll in silver money. This granted, we should have no occasion to borrow or beg. We should have simply to issue 20,000 Hungarian national bonds, of 100 florins each, to make up the 2,000,000 capital, put this paper money under the protection of the state, and after paying on it 5 or 6 per cent. interest, redeem it by an annual drawing. In this manner the bridge may be built without costing any one a kreutzer. Those only who use it will gradually and insensibly pay for it, our two cities and territory be connected, and the 2,000,000 after a certain time be paid off.

A sufficient fund may in time be obtained for the annual cost of upholding the bridge; after that the bridge may be thrown open to the public toll free; or should it be the wish of the country to continue the toll, a means may thereby be afforded to us of embellishing our two cities, and by good regulations so cleansing and purifying them, that they may rank among the first cities in Europe. By the payment of a kreutzer each time of passing the bridge, or by an annual subscription of a few florins, we should gradually see the erection of buildings and monuments that would incessantly excite our admiration and astonishment, and we should be able to boast of having achieved so much of the useful, agreeable, and ornamental, with comparatively little inconvenience or burden; we should learn to co-operate and unite for practical purposes, and we should become better acquainted with our strength and resources, which neither the floods of the Danube, nor the mountain heights around us, nor anything else, could resist.

We well know, honourable Committee, that this our project will at first produce no favourable impression on the public, but we shall not the less recommend this course to your notice, resting assured that it will ultimately be approved of and adopted.

The first objection we shall hear will be, "What a pity to issue paper money, incur national obligations, tarnish the halo which has hitherto encircled us, of being debt free!"—"Our laws recognise gold and silver money only." Our answer is easy.

Inasmuch as the value of gold and silver does not surpass that of iron, is perhaps even inferior to it, but owes its appreciation to its durability and scarcity, and is therefore received among nations as

a good representant of commodities; in the same way, paper money, though possessing no intrinsic value, may represent any amount of gold and silver, according as it is based on good or bad security. Water itself may destroy life, yet there is no living without water. Fire, our best benefactor, may become our fiercest enemy. Medicine may kill as well as cure, and the knife which cuts our bread become an instrument of murder; even so the issuing of paper money and the incurring of debts turn to our greatest benefit or harm. The conclusion we naturally arrive at is, that the benefit to result from things depends upon the use made of them, and that we have it in our own power to remedy the evils of paper money and loans, and by a right use of them to promote the prosperity of our country.

Were we to build the bridge with our own paper money, in twenty or thirty years at most the whole sum would be obtained from the income of the bridge, and no debt remain. Would then our conduct be blamed, and should we be reproached with having injured our country? We think not; for, as in trade and industry it is dangerous and detrimental to incur debts from extravagance, it is, on the other hand, a proof of extraordinary short-sightedness and want of judgment not to borrow, when there is clear and certain gain; in other words, it is folly when money yields only 3 per cent. to raise it at 5 per cent., and thereby incur an actual loss of 2 per cent., which in time would infallibly eat up the capital. The reverse is equally absurd; viz., not to borrow at 5 per cent., with the undeniable certainty of making 8 per cent.; for as, in the first case, there would be a certain loss, in the second, the capital would as certainly be redeemed.

If this is actually the case, can we any longer doubt that it is prudent and wise in the nation to pass a law for the issuing of 2,000,000 florins national bonds, for the erection of a Pesth and Ofen bridge? Provided—1st, That its construction does not exceed 2,000,000 florins. 2nd, That it produces an annual income of 200,000 florins. 3rd, That the annual expenses do not exceed 40,000 florins.

The money which the country borrows at 5 per cent. will, strictly speaking, produce 8 per cent., and therefore there will be a clear gain of 60,000 florins annually, which may be appropriated to cancelling the debt, or any other purposes that may be thought fit.

We trust we have shown how trifling the objection to paper money is, and how foolish and impolitic it is to abstain from borrowing money and incurring liabilities in certain cases, as it is to borrow and get into debt in every case. Suppose, for example, a man had an opportunity of buying an estate that would return him 8 per cent at once, and was capable of great improvement, would he act wisely in not buying it, provided he could find the purchase money for 20 or 30 years at 5 per cent., or for as long a period as would be necessary to cancel the debt out of the surplus of his profits? Should we not consider him a fool to decline such a purchase? What shall we then say of a nation, honourable Committee, whose main prosperity depends on its industry and a thriving commerce, whose soil admits of immense and endless improvement, and which wants only capital for the development of its resources? What shall we say of this nation, if it be so prejudiced that it will not borrow money at 5, which will return 8 per cent.? What, but that it has neither energy nor enterprise. Let us trust, then, boldly to the spirit of truth, which will sooner or later, but infallibly, teach the inhabitants of our dear country the art of working wonders in poor and unpopulous countries, by means of the system we have been advocating—the Bank system.

If national bonds of 100 florins are issued to the amount of 2,000,000 florins, it is the same as if the country had borrowed this sum, but with this difference, to which we call particular attention, viz., that the nation is its own debtor. Interest at 5 per cent. on the above capital will cost the country 100,000 florins annually; if, therefore, the bridge return an income of 160,000 florins, exclusive of keeping it in repair, the country will then have its bridge, and all the benefits, direct and collateral, belonging to it, and be a gainer of 60,000 florins besides. We therefore strongly recommend our plan to the honourable Committee and to the representatives of our country—a plan which, for industrial and commercial undertakings, no person would disapprove, and a nation ought not to reject. And why not? Simply because the creation of a Pesth and Ofen bridge is of little consequence compared to the establishment of our Bank system, which would originate endless improvements, and enable us to accomplish the greatest works, converting our land, in the course of time, into a paradise. So long as man is man, only make it clear to him that his interest

and advantage are involved in an undertaking, and he will achieve things almost impossible. Building our bridge in the way we propose, will offer a useful and valuable guide to us on future occasions, when greater works and larger profits are in contemplation.

How many projects does not our country offer, which would return 18, 20, or even 50 per cent.? Who doubts that want of money is the cause why our rivers are neglected, our marshes undrained, our means of communication few and bad? If these be facts, and they are undeniable, would it not be wise in a nation to borrow money, at a moderate interest, and drain its marshes, when a large per-centage might be gained thereby? But between a nation and a private individual there is a difference; a man cannot be his own debtor; and such operations as improving the Danube, draining and restraining the Hanság, the Sarrét, &c., exceed his means; whereas a nation may be its own debtor, having greater resources at its command, and be safe against the debt being called in. Who are we to look to, if not to the nation, for the improvement of our numerous rivers, and for the recovery of vast tracts of useful land?

Although, in certain cases, it is well and prudent to borrow money, as a general rule it is dangerous to do so. The facility of obtaining is apt to seduce us into extravagant and hazardous undertakings, which, when carried into execution, prove ruinous and unprofitable. We think it highly objectionable to borrow money imprudently; but are we never to borrow for really profitable purposes? buy nothing whatever without first having the purchase money in our pockets? that is, if we may be allowed the illustration, are we never to use a knife, for fear of cutting our fingers; or fire in our hearth, for fear of being burned? All things depend on the use made of them; the same thing may, in good or bad hands, be a blessing or a curse.

The objection we have considered is untenable; but we fully admit the dangers to which the borrowing of money exposes individuals, who are easily influenced by their passions and weaknesses, and, blinded by hope, fall victims to delusions. A legislative body, composed as it is of heterogeneous elements, is less easily led astray; its deliberate and cautious movements give time for the extinction of those false hopes and empty illusions,

which might be dangerous, if unchecked. The Bank assignats of France, and the enormous debt of England, are fearful examples against the issue of paper money. But, Honourable Committee, there is a very striking difference, and one we cannot lay too much to heart, between our case and theirs, which, independently of the consideration that the French paper of former days and the present English paper must be regarded in a totally different point of view, (a matter we shall not now enter into,) shows quite clearly that the Bank system, now advocated, cannot fail to be as beneficial to us as it was formerly to the United States. It by no means follows that it must be applicable to France and England, but merely that the benefits of such a system must depend entirely upon circumstances, or rather upon the condition of a country. And, in truth, where improvements afford a profit of 20, 30, and 100 per cent, as is often the case in America and Hungary, paper money answers exceedingly well, as the debt is sure of being cancelled; but where, as in England and France, no such profitable undertakings are possible, the system is inappropriate and may do harm. A calculation was lately made, that the cost of a Danube embankment, in the county of Pesth, by which 400,000 acres of arable land would be obtained, would come to about 700,000 florins, C. M. An acre of land, which, in many parts of the county of Pesth, lets for 2 florins per annum, would cost only 1 fl. 45 kr. Thus this embankment would not only repay in one year the capital expended, but bring in some hundreds of thousands of florins annual rent, and so pay an enormous per centage on the original outlay.

Does not this palpable example of immense profits teach us that, as it would be inexcusable if the parties interested did not, by every possible means, procure the sum of 700,000 florins, and carry out this advantageous project, it would be quite as inexcusable, and gross carelessness, in a representative body of the year 1833, if it did not legalise certain sums for such remunerative undertakings as a Danube embankment? and who can doubt that, by and by, numerous similar works will be met with here, as in America, for the completion of which, not merely 700,000 florins, but several millions will be required; and which, while these millions are not forthcoming, must either be abandoned altogether, or gradually carried out by the issue of paper money from time to time. The substance of what we have said is this, that, as it would

be lamentable folly to create money without mature deliberation and sound calculation, and so lead ultimately to ruin; it would, on the other hand, be an intolerable grievance to pine away among unhealthy marshes, be eternally without communications, and obstinately sacrifice to paltry and wretched prejudices all national impulse or development.

Our country is capable of endless improvements! Let us only adopt this grand system, so especially suited to us, and nothing will be impracticable: if we reject it, we shall have to renounce all that is dearest to us, all that will, in reality, exalt our country, and, by degrees, make the Hungarian rank among great nations. Unless all parties do their best for the internal development of their country, unless we venture to adopt the means already proposed for our benefit and advantage, we must not once dream of all that which would satisfy our wishes, and present the spectacle of a well-developed national character; or, if we resign ourselves to such dreams, we shall find, when we awake, that we have been grievously deceived.

The Committee will perceive, from what we have here advanced, that, in our anxiety for the mechanical part of the bridge, we have not merely had in view the easier passage from one bank of the Danube to the other, but contended for a far more important advantage, a moral one, viz., the good that must necessarily accrue to other similar undertakings from the solid and practical conclusion of one great work. If it can be shown by facts, that works like the Pesth and Ofen Bridge, offering only 3 per cent., can be successfully carried out by a system, whose two leading principles are the imposition of a general and equal tax upon all inhabitants of the country, and the anticipation of a sure profit; as a matter of course all those operations which yield 4, 10, 50, per cent. will quickly follow. How many of these treasures lie hidden in our land, which, so to say, await only our turning to account that they may become the firmest supports of our country and the throne, and fortify the nation against all chances and accidents, who that knows anything of Hungary can for a moment doubt?

This collateral purpose, we might almost call it this principal one, we consider ourselves fortunate in being able to bring forward, as it gives us an opportunity of setting forth, in its main features, a

system which has borne the test of experience, and at once overthrows all the objections which have been advanced against our patriotic undertaking; such as "What is the use of a bridge, unless you have good roads? "Let these in the first instance be attended to." "Why build a bridge, before you have regulated the Danube?" "Of what good can a bridge be to us, with a trade so borne down by heavy duties in foreign countries that it can never prosper?" To such objections we can only give a brief answer, or our report would swell into volumes. The Pesth and Ofen Bridge will be less useful to us as a mechanical structure, than for its moral effect in encouraging the practical carrying out of a grand system. Though the profit be only 3 per cent., it will be far more serviceable than any other undertaking, however profitable. Now that the Diet is summoned to meet by one of the best of Princes, there is no one object that unites so many voices in its favour as the building of a bridge to unite our two cities. Every inhabitant of Pesth and Ofen cherishes the wish, a few wiseacres and egotists only excepted; every citizen of our land, who looks beyond the next day, desires it; indeed, the spirit of the times absolutely demands it, and will no longer tolerate the division of our territory by a river.

The positive erection of the bridge by this means will convince many that neither gold nor silver is the basis of a nation's wealth, but that development of human intelligence which, having profit and interest in view, leads to the discovery of some preliminary instrument, by the proper application of which the most gigantic projects may be achieved. The everyday silly talk of "wanting money and means," to which we particularly ascribe our country's backwardness, (mechanically speaking,) is difficult to remedy, because most persons consider that an impulse to prosperity can only be given to it by an inanimate white or yellow metal, which for many thousand years, perhaps, has been lying in masses on the surface of the ground in South America, without having raised its inhabitants nearer to a condition becoming humanity; a condition not to be acquired by gold and silver, but by that mental energy alone, which is inherent in us, and constitutes our immortal part. It is this power which teaches us to reflect, which, according to our condition in life, rouses us to a consciousness of our wants, which stimulates us to industry and activity, imparts a

charm to our existence, and, by exalting our animal condition, converts our dwelling-place into an Eden.

The establishment of a National Bank, now only advocated by a few, will become a general wish, and eventually be realised. The halo of credit, which some, to the prejudice of our national faith, have so shamefully tarnished, will, in some measure, be *de facto* restored, even before the mechanism of our national credit be perfectly in order. It will become clear, that as shares and a Bank system are best adapted to profitable undertakings, there are, nevertheless, others—such as Bridges, Theatres, Museums, Polytechnic Institutions, Institutions for the Fine Arts, &c., offering no other than an intellectual dividend—to which a banking system would be of no direct advantage, and only so far indirectly contribute, that in making our countrymen rich, it would enlist their good deeds as well as good wishes, and enable them to promote all such useful objects. Hungary, a country now comparatively unknown, will soon take its place among polite nations, the success of one great work will operate beneficially towards the achievement of many others, which it is impossible to foresee; so that the mechanical connection of our two cities and our territory may form but a small part of the good which will result.

What importance, then, shall we attach to the objections of those modest reasoners, who are incapable of embracing the real point of the case, and argue thus—"Why so very costly a bridge? that the inhabitants of the two cities may pay visits with greater convenience?" Besides, we have our bridge in summer, and oftentimes in winter the Danube does not freeze; why not, therefore, let us have something else?"

It rests with the Honourable Committee to decide what weight is to be attached to these objections and remarks, when the philosophy of the matter against which they are directed is considered, and also what value they have when brought against our plan. Our want of space will not admit of our refuting them.

We cannot, however, leave unnoticed the "Memoir of Alexander Györi, upon a permanent Bridge between Pesth and Ofen," which has just appeared. It contains a great deal that is good and acceptable; but, in our opinion, it would not be advisable, for two reasons, to adopt his preliminary proposal and assume his premises.

First, because the mortgage for the money, with which our honoured countryman proposes to build his bridge, is a very poor one. His calculation is, that the building ground ultimately to be gained from the river, and now constituting a portion of its bed, will be worth 54 florins, C. M., per square klafter. This undoubtedly will be its value in a few years, for both cities will progress equally; but whether now, or by and by, purchasers enough at this price will be found for ground which is liable to be flooded by the Danube, is now in possession of that river at low water, and has been so for centuries, we may be allowed to doubt. Secondly, because his proposal leads to delay, and delay, in our country especially, is fatal.

The remarks in the pamphlet, "that no safe and permanent bridge is practicable before the Danube is regulated and improved," are controverted in all parts of the world; for how many bridges are there not over rivers whose waters are unrestrained? and in what condition would the communications in the United States be, if the rivers had first to be regulated before a bridge could be built? Were, however, the views of Herr Györi incontrovertible, what more do they prove than the impossibility of building a bridge over the present bed of the Danube which shall last for ever; and that the bed of the current must be kept constantly clean, to prevent the piers in it from being undermined? Suppose they prove nothing more, why then shall we postpone the matter, and delay, probably for centuries, a work which will be of incalculable benefit to us, pay itself in thirty years, and then be thrown open toll-free to the country. There would be no reason then against commencing it forthwith, were we positively certain that it would be destroyed in thirty years, whilst the indirect good it would effect would not be lost to us. And is, then, our Danube so irregular and raging a stream, that no bridge can be built over it which will last more than thirty years? Herr Györi himself is not of this opinion, especially if the bed of the river be kept constantly clean by proper machinery. Herr Györi's proposition might be very well, were this true; but the nation's business is to build a bridge without delay, which, well secured, shall last for centuries. At the same time, it ought to take steps for the regulation of the Danube. It is quite certain, that the nation will not only be a gainer of the 3,900,000 florins promised by Herr Györi, but will have effected,

mechanically and morally speaking, a change in the country that may be designated as a new era in the regeneration of Hunnyad.

We must also notice the important observation relative to the two millions of our national paper money, maintaining its true value or not, *i. e.*, whether the 100 florin bonds may not probably fall to 80 or 90. We answer, that the value of the bonds to be issued will infallibly be maintained in proportion to the security or insecurity of the mortgage. If the mortgage is good, or the public considers it so, and if the interest is regularly paid, and the bonds redeemed by lot at 120 or 150 florins, then may we hope, that our bonds will not only be at par, but rise considerably above it. The bridge itself will serve as the mortgage, and can easily be assured, if not entirely, yet with respect to the ironwork; and in no case will there be any great danger to apprehend. But, in order to quiet the public at large, and raise the price of our paper money, it would be as well, if only for the credit of the thing, for in all other respects it would be unnecessary, to have another mortgage besides the bridge. For this latter purpose we think nothing so good as the high salt tax, if Government will agree. The security would then be perfect. We may reasonably hope we shall have no difficulty with the Government, as the favour would be no greater than that which a man would confer were he to give his creditors priority of claim to his house or grounds, by which perfect security for the capital would be obtained without the house or grounds being actually given up.

Lastly, we must declare our honest opinion on those observations relative to the Government counteracting our efforts. We do not think it at all likely the Government will thwart a system so advantageous, which hurts nobody, but makes use of the treasures concealed in the bosom of rude nature to promote the interests and prosperity of a country, which constitutes the best security of the Austrian monarchy. Where there is a will, there is a way; and, therefore, the Government, whose manifest interests are allied to the greatest possible augmentation of the means and contributions of Hungary, the improvement of our communications, the regulation of our waters, the development of our mechanical industry, will throw no obstacles in our way, but do its best to promote all such objects; in short, it will do all in its power to increase our wealth, to multiply our resources and strength, and to promote the general

welfare and general contentment, which have ever been and ever will be the surest supports of a throne.

The adoption of a good system, in building a bridge between Pesth and Ofen, will, as we have already said, conduce to the prosperity of our material industry, diffuse employment, and lead to consequent contentment. It is not in the least probable that the Government will throw impediments in the way; on the contrary, we expect to find in the Government our firmest supporters.

And here, Honourable Committee, we close the political part of our recommendation; and, without inconveniently lengthening our Report, we will beg to add a few words on the practical carrying out of the undertaking.

Before all things we must avoid entrusting the superintendence of the work to a person who has never been engaged in a similar undertaking: neither testimonials, calculations, nor promises must be admitted under any pretext whatever, but a good builder must be chosen, who has given proofs of his capacity by the great works which he has executed standing in full indestructibility. This matter settled—and of the propriety of doing it in the above way no one can doubt, who calls to mind the many undertakings with us that have entirely failed from having been constructed by mere theorists—we must look to England or the United States for the artists we require, for there only, and no where else, are to be found works, where the difficulty of accomplishment is about equal to the complexity of the problem, which the construction of a Pesth and Ofen bridge has to solve.

And if this be the case, Honourable Committee, we shall take the opportunity, when the subject is brought before the supporters of our Committee, his Highness the Palatine, and the Diet, of requesting that a "Regalist" deputation be appointed, to digest, arrange, and subject to the strictest investigation our diffuse information and data; and at the same time that competent persons be sent abroad to enquire more minutely into matters which we have but superficially and partially handled.

Our Report is wanting in many respects; our calculations may be erroneous; certain fundamental questions, such as the revenue of the present bridge of boats, we have hardly touched upon; we have been unable to say anything positive about the insurance of the bridge; numerous subordinate considerations we have not even

mentioned; and the more we weigh the matter, the more evident it is to us that we have done little for it, and must renounce all hopes of its being executed, unless the Honourable Committee supports the undertaking by its powerful influence with the States of the Land, who alone are able to do it, and, in our humble opinion, would in no way compromise themselves were they at once to pronounce their creative "fiat."

This single word, which would diffuse over our territory the greatest benefits, would not only reward us a thousandfold for all our pains, but would bind us in an eternal debt of gratitude for the remainder of our lives.

Commending ourselves to the favour and indulgence of the Honourable Committee, we remain

The Honourable Committee's

Most obedient Servants,

GRAF GEORG ANDRÁSY,
GRAF STEPHAN SZÉCHENYI.

MEMOIR OF COUNT SZÉCHENYI.

FROM PAGET'S "HUNGARY AND TRANSYLVANIA." 1839.

COUNT SZÉCHENYI ISTVÁN, is the third son of the founder and benefactor of the Museum of Pesth—a scion of the same house which produced two of the most distinguished archbishops of Hungary. For seventeen years Széchenyi served in the Austrian army, and it was not until the peace had rendered it an idle life, and removed all chance of distinction, that he determined to quit it. Perhaps, disgusted by the system of favouritism, or the personal enmity which had kept him down to the rank of Captain; perhaps moved by that spirit of regeneration, which, from the mountains of Transylvania, spread over the plains of Hungary, and was felt even at the gates of Vienna itself; or, it may be, warned that the freedom with which he had dared, under the influence of this spirit, in his place as a Hungarian magnate, to address the Upper Chamber, was inconsistent with the uniform he wore; such have been suggested as the causes which may have driven him from the army, and which soon placed him in the foremost rank of Hungarian patriots.

The leisure which he now enjoyed was occupied in foreign travel; England particularly fixed his notice. Our manners, our institutions, our commerce, were objects of his study, and offered him useful hints for the improvement of his native land.

The causes which impeded the introduction of commerce in Hungary, and the great development of her natural resources which must result from their removal, first occupied his attention. At home, he found a government and people, mutually distrustful.

The Hungarians complained to him that foreign—so they called Austrian jealousy and oppression — were the sole causes of all their misfortunes, while, beyond the Carpathians, he heard his countrymen described as a tyrannical, ignorant, and turbulent nobility; the oppressors of a poor, idle, and slavish peasantry—the one class who would not, the other class who could not, effect anything for the common advantage of their country. On all sides a reform in Hungary was declared impossible.

Széchenyi was not to be turned from his object. His plan was cautiously laid down, and has been, so far, steadily followed up: to labour incessantly at improvements, and to pursue such only as the strength of his means gave him a reasonable hope, that, with unwearied perseverance, he might carry through. In common with others, he had always striven for the great objects of reform in the laws and institutions of the country; an extension of the rights of the lower classes, and a more equitable and just government. But his great and peculiar glory is the path he has marked out, alone, and which, in spite of all obstacles, he still pursues with the greatest success, viz.: the improvement of the material condition of Hungary. One of the first objects to which Széchenyi drew the attention of his countrymen, was the improvement of the breed of horses—a subject particularly suited to their tastes, and likely to attract their notice. A large stud, often from one to two hundred horses, forms almost a necessary part of a nobleman's establishment, and yet they rarely breed anything but a cross of the common country horse, with the large, slow, high-actioned Spanish horse—a race of little use but for the pomp of ceremony. Széchenyi introduced the English racehorse and hunter, and to show their superiority, he instituted races, and kept a pack of hounds; in short, he succeeded in making English horses a fashion, which is now generally followed.

The races take place twice a year at Pesth about the end of May, and at Parendorf, near Presburg, in autumn; and are so well attended that it is evident that they suit the tastes of the people, and it is highly probable that they will one day form a part of the national amusements.

An improvement in the breed of horses was an object well worthy Széchenyi's attention, and nothing was more likely to promote it than the establishment of races in the capital; but some have thought that objects of a deeper interest than the

encouragement of thorough-breds might have been dreamed of in their institution.

The Diet ought, by law, to sit every three years, but when the government is strong, it sometimes dispenses with its services, as it did during and after the last war for twenty-five years, and then the nobles have no object of common interest to bring them together.

When minds clash not with minds they are apt to grow rusty, and lose some of their sharpness and polish; a thousand useful ideas and beneficial projects, a thousand high resolves and patriotic schemes, expire untried, unheard-of, from want of opportunity to communicate them to others.

This opportunity to meet and communicate the races afford; without a pretext for interference or interruption: many come, they know not why; the master-minds command, and they obey.

The system so long and so ably followed up, of Germanising Hungary, had succeeded to such a degree as to destroy, to a considerable extent, the feeling of nationality among the higher nobles; most of them were ignorant of the language, few of them took any interest in the affairs of Hungary, except in the preservation of their own privileges, and some even affected to despise their countrymen because of a little outward rudeness, of which the absenteeism pursued by the more polished and wealthy was the main cause. Fortunately the well-wishers of Hungary knew how influential a principle the spirit of nationality is, in the regeneration of a country, nor did they forget how strongly the language of one's childhood, with which man's earliest and dearest associations are connected, acts in exciting that spirit.

The restoration of the Hungarian language was, therefore, the first object. Széchenyi himself, from disuse, was no longer master of it; he made himself so, and became one of the most influential in its diffusion. He was the first in the Chamber of Magnates who spoke in Hungarian; till then Latin was always used in the debates, as it still is by the Palatine and the court party. Few thought of reading Hungarian—fewer, except some poets, of writing in it. Széchenyi published several political works in the language, and Hungarian authorship has become fashionable. Among men it is now the medium of conversation; at public dinners, toasts and speeches in German would not be listened to,

and at Pesth, whatever may be the case at Vienna, Hungarian gentlemen are now ashamed to be thought ignorant of the Hungarian language.

The establishment of a society for the development of the Hungarian language, was proposed by Széchenyi in the Diet, and was, as usual, met by innumerable objections; of which the want of funds was most cogent. "I willingly contribute one year's income," (6000*l.*) said Széchenyi—"I second it with 4000*l.*," said Count Karolyi György: the example was catching, and 30,000*l.* was soon subscribed.

I have some hesitation in speaking of the writings of Count Széchenyi, for I have never been able to master the difficulties of the language, and we all know that translations, even the best, convey but indifferently the spirit of the original. Many of his works, too, have not been translated, and of these, I can only give the title-page. It would be, however, too great an omission not to speak of what has produced so great an effect, and I shall, therefore, give a short analysis (from the German translation) of his "Hitel," or "Credit," the work which has been most read, and which has gained him the most fame.

The "Hitel" is an inquiry into the causes of the want of commercial credit in Hungary, with suggestions for their removal.

In the introduction, Count Széchenyi attacks one of the great drawbacks on Hungarian progress—the want of a common purpose and a common opinion. "All are anxious to build," he writes, "and every one at the same building, but, unfortunately, each wishes to lay his foundation-stone in a different spot, and begin his work in a different style. Many would like to commence in the middle, and some seem to think the best plan of building a house is to begin with the roof. Few set themselves to work at the foundations. 'Oh! if the Ludovica road in Croatia were but toll-free!' says one. 'Give me rather a suspension-bridge between Buda and Pesth,' answers another. 'First of all, let us lay out a promenade along the banks of the Danube, and plant it with trees, and while they are growing up, we shall have time to ——' 'No, no, I say a Magyar theatre, and the Magyar language, that will keep up our nationality!' 'Ah,' says another, 'if our rich magnates would only come and live at home, instead of spending all their money in foreign lands, and take a part in our county

meetings!'—'Tut, man!' grumbles a neighbour, 'that's nothing, if they would not bring those nasty foreign fashions into the country—those shoes and stockings, instead of stout Magyar boots, and those great hairy—what do you call them? *Colliers grecs*, in which they hide their honest Magyar faces!' 'The paper-money is our ruin, friend!' observes one; 'if we could only get hold of Kremnitz ducats, and keep Hungarian gold and silver within the boundaries of Hungary, then ——' 'Nay,' answers a second, 'but the salt-tax! if the salt-tax was but lower!'—and so on to the end of the chapter. Every man believes his own plan so much the best and wisest, that, without it, no step can be made in the march of Hungarian improvement."

Széchenyi next tries to persuade them that inquiry into their state will show them that their country is capable of much more than is at present supposed; enlisting even the laziest in his cause, by the lightness and familiarity of his illustrations. He then begins the more formal part of his work by proving that the Hungarian landholder is poorer than he ought to be, from the quantity and quality of his possessions, and that he does not possess those comforts which his circumstances ought to afford him.

He next shows that the Hungarian proprietor cannot, at the present moment, cultivate his land to the greatest advantage, because there is no mutual understanding among Hungarians, no commercial credit: while the common holdings of land, the monopolies and limitation of prices, the loss occasioned by compulsory labour, and the collection of rent in the form of tithe, all tend to impede improvements in agriculture.

From this Széchenyi goes to the subject of Commerce, and the causes assigned for its low state in Hungary are examined, the geographical position of the country, the want of capital, the inability to compete with other countries, and the amount and uncertainty of duties on exportation,—and he might have added, with more force, on importation,—are illustrated with a facility peculiar to the author,—the immediate causes of the want of commercial credit, he considers to be the excess of regulations, the deficiency of productions, the defective state of communication, the expense and uncertainty of existing means of transport, and the absence of that strict commercial probity, without which an extensive traffic can scarcely exist.

The means by which this credit is to be obtained, Széchenyi points out, and contends, especially, for the establishment of laws for the more certain and easy recovery of debts, and enforcement of contracts; and he combats most forcibly the arguments brought against this, on the score of the danger of extensive commercial speculations, the unconstitutional spirit of the laws delivering over the noble into the power of his creditor, the ruin and downfall of old families, which, it is thought, must be the consequence of them, and such reasons as an Englishman may hear every day, from a certain quarter of the House of Lords, in a debate on the usury laws. Here, as well, indeed, as throughout the whole work, the prejudices and follies, the ignorance and false pride of the Hungarians, Széchenyi has most severely lashed.

The example of England is frequently held up for imitation, and to the common objections cast against it, Széchenyi gives an answer, which shows how well he appreciates and understands the best part of our institutions:

"It is impossible," he observes, "to have visited England, and to have seen the vast progress which free institutions have enabled her to make, whether in material improvements, or in protecting the holiest rights of humanity, and not pity those miserable creatures who traduce so great a nation. England has faults as well as virtues, for earnestly as men may strive after perfection, and far as they may advance in the path, they are not doomed to reach the goal. But there are men who have no soul for what is good, and great, and beautiful, they ever seek and find nothing but the filthy and the bad—they are the unclean birds of society, and delight only in its carrion. Of such are the slanderers of Britain. They seek only the dark side, and they find it dark enough, no doubt; but from the light they turn away. There is much that is bad in England, from which God defend us! Above all, her 'intolerance' is always the first charge of her enemies, and that reproach we may make against her with a clear conscience, for, among ourselves, thank God! no trace of it exists. Then 'the misery of her manufacturers' is brought forward, and it means, perhaps, that they cannot every day eat beef and drink beer, to which they are accustomed, and of which, if deprived, they grumble at. With us more men live without meat than with it—many Wallacks never taste even a bit of good bread their lives long, and in the

neighbourhood of D—— there are hundreds who live throughout the summer on nothing better than water-melons. 'But,' perhaps, you exclaim, 'how happy they are, never to have known anything better'—enviable fellows, certainly!—'Then Ireland! * what do you say to Ireland?' Alas! it is too true, and we may well wonder that the English were compelled, from insubordination, to the necessity of depriving so large a portion of their countrymen of their common rights, without otherwise allowing a large portion a share in ruling it, while others enjoyed all the privileges, and all the wealth. Nothing could be worse than that!—'The National Debt.' There, indeed, we are more fortunate; of national debt—(not very oppressive to individuals after all)—we have none—but we have a precious quantity of personal debt, and by it we are crushed to the very earth. But are not such objections absurd? Is it not, fairly considered, seeing the mote in our neighbour's eye and passing over the beam in our own?"

If the "Hitel" were put into the hands of a mere political economist, he might find it, perhaps, too diffuse, superficial, and crowded with proofs of what he might imagine no one was ignorant; but to one acquainted with the country and the people for whom it was written, the book assumes a very different character. He is astonished with how much delicacy the best parts of the Hungarian character are seized and worked upon, how such prejudices as impede the progress of improvement are ridiculed and exposed; with what a richness and familiarity of illustration principles are taught, so that persons to whom such discussions are quite new, must still be struck with them; and with how much skill the author has managed in a treatise on political economy, to throw out hints to his countrymen on almost every subject, moral, economical, and political, which the actual circumstances of the country render important. The great lesson which Széchenyi constantly endeavours to impress upon his readers is, that the reforms necessary in Hungary, depend on the will of the Hungarians—that they have only to bestir themselves to effect a complete change in the moral and material aspect of the country.

The first reception of the "Hitel" was anything but encouraging; the satire was ill relished by those against whom it was directed;

* Before this work was finished, Ireland was reinstated in her natural rights.

its author was abused, written against, and, in one instance, the work itself was burnt by the common hangman, by order of a county meeting. Such was the state of feeling in 1830. In 1835, Count Széchenyi was receiving addresses of thanks from almost every part of the country; in Transylvania a magnificent gold pen was voted him, at a public meeting, as the most useful of Hungarian authors; and everywhere his name had become a watchword among the well-wishers of Hungary.

Among the later works of Count Széchenyi are the "Vilag" (Light), an answer to a pamphlet published by Count Desewffy, against the "Hitel," and a work on the practicability of a permanent bridge at Pesth.

Of the style, of course, I speak only from hearsay, when I pronounce it among the best in the Magyar language. To the accusation of coining and introducing new words, every one must be liable who speaks of ideas new to the people, and uses names foreign to the country. Some persons complained that they had turned over their Magyar dictionaries in vain for the word "Macadamise," which they very innocently conceived to be a creation of Széchenyi's.

In Hungary, a want of unity among the different ranks of the nobility, an absence of a common feeling, and of something like a general opinion, have been long among the most acknowledged causes of inaction. Every class discusses apart the subjects of immediate interest, forms its own opinions of public events, and its own plans for public reforms: the accordance which gives strength and force to action, is wanting. This deficiency was universally acknowledged; but without a free press, and with a Diet sitting but rarely, and then at a distance from the capital and centre of the country; without reports of the debates, without even a national literature, and in the midst of the bitterest jealousies of caste and class; what remedy could be proposed? Széchenyi had seen the clubs in London, and with that singular talent which he eminently possesses, of appropriating and adapting whatever he finds good in other countries, to the wants and deficiencies of Hungary, he easily perceived how useful their organisation might be made to effect a greater purpose than that of serving as mere pride-protectors for poor gentlemen, or of furnishing the selfish enjoyment of the greatest luxury at the

cheapest rate. A club, or to avoid a name associated on the Continent, with certain reminiscences of the French Revolution—a Casino, while entirely free from any political scheme, would afford to all the upper classes an opportunity of meeting, and of becoming better acquainted with each other's good qualities; it would harmonise and generalise opinions, and improve the manners and tone of feeling, besides affording opportunities for reading all the journals of Europe, an advantage which few private individuals could command.

At Pesth, accordingly, a Casino was established, on the most magnificent scale, as we shall see hereafter—and now, no less than one hundred exist in different parts of Hungary and Transylvania.

One of Széchenyi's favourite plans is, the embellishment and aggrandisement of Pesth. For this purpose he has laboured to have the Casino on so handsome a scale; to build a national Magyar Theatre; and, more than all, to raise a permanent bridge between Buda and Pesth. At present* there is only a bridge of boats between the two towns, which is taken up during six months in the year; and the whole communication during that period is carried on by means of ferry-boats, or over the ice. At certain times, particularly during the freezing and thawing, not to speak of storms and fogs, this produces much inconvenience, and is often attended with great danger. To remove so great a drawback to the prosperity of the two cities, Széchenyi has proposed to build a bridge across the river, either of stone or iron, as may appear best; and as the width is only a quarter of a mile, it would not appear so difficult an undertaking. Of course it was declared impossible. One said, the Danube was too wide, another found it too deep; a third declared, if the bridge was all finished the first winter's ice would carry it away. English as well as German engineers have thought otherwise; and it is a certain fact that Trajan's bridge, three hundred miles lower down, stood firm enough till Hadrian destroyed it.

These, however, were not the greatest impediments to be overcome. Count Széchenyi had a still greater object in view, than the improvement of Pesth, in building this bridge. He

* This work was published in 1839, since which the bridge has been opened to the public, and all danger of a stoppage of communication is at an end.

proposed to teach the Hungarian nobles the advantage of paying taxes. The bridge was to be built by money raised in shares, the interest on which was to be paid by tolls, to which every one, noble or ignoble, should contribute. What! a Hungarian noble pay taxes! A hornet's nest is a feeble comparison to the buzz these gentlemen raised about Széchenyi's ears. It was no matter: he inveighed against them at the Diet; he wrote at them in the journals; he ridiculed them in private; and in the end he conquered them. A bill passed both Chambers, by which the legal taxation of the nobles, in the form of a bridge-toll, was acknowledged. The Judex-Curiæ shed tears on the occasion, and declared "he would never pass that ill-fated bridge, from the erection of which he should date the downfall of Hungarian nobility."

Of the petty opposition which Count Széchenyi had to contend with, and the means by which he overcame it, I cannot speak here. I did not believe that any man possessed the indefatigable energy and perseverance necessary for the task. It requires a truly patriotic spirit to endure those miserable checks which arise from the selfishness and meanness of the very persons one is labouring to benefit. The corporation of Pesth did not think they were justified in giving up the tolls which the present bridge of boats brought them in; the proprietors of land would not sell for such a purpose; the owners of houses here, feared the new bridge would be there, because they knew it would be better there; the very toll-keepers had their friends and supporters, whose opposition at times made even a Széchenyi doubt of success.

One of Széchenyi's greatest achievements is the steam-navigation of the Danube. This is, however, his own in idea and in accomplishment. It is now about six years since he first undertook the voyage from Pesth to the Black Sea. A comfortable-decked boat, a good cook, and a pleasant companion, with the means and appurtenances for shooting, fishing, sketching, and rowing, were not bad preparations against the fatigues and dangers to which he expected to be exposed. The comparative ease and safety of the navigation, the magnificence of the scenery, the size and importance of the tributary streams which poured their waters into the Danube, and the richness of the country on its banks, were

secrets revealed to a mind which felt their full force, and happily knew how to employ them. Of course the timid set him down as mad for undertaking such a journey; but when he returned, and ventured to whisper the possibility of steam-navigation, even his best friends shook their heads. "Steam in Hungary! Yes, indeed, in another century," said those who never think the present the time for action. "Steam, indeed, in the shallows and rapids of the Danube! No: if we must have steam, why not take the plains? Nature has laid them out for railroads," said others, who oppose everything practicable by proposing something impracticable. Széchenyi let the first wait their time; to the second he recommended a speedy commencement of the railroad, that the country might derive advantage from one, if not both, of their schemes.

In pursuance of his own plan, Széchenyi went over again to England, studied carefully the principles of steam-navigation, brought over English engineers, and when at last certain of the practicability of the scheme, formed a company and purchased a steam-boat. It was in October, 1830, that the first steam-boat plied between Semlin and Pesth. The communication is now complete from Vienna, and will soon be so from Ratisbon to Smyrna. Thirteen vessels are employed, and a number more are building.

To detail the advantages of this undertaking in extending commerce, in developing the resources of the country, or in opening the road to civilisation, by the spread of intelligence, were only to narrate what every one knows steam-navigation has effected, and will effect, wherever it is introduced; but in Hungary it has done more, it has engaged one of the proudest and richest aristocracies in Europe in a profitable commercial speculation! We shall show elsewhere that it is to the exclusive privileges of this aristocracy that Hungary must impute in a great degree her want of commerce: how great a point has thus been gained will be easily understood.

At first, some of those whose hearts were better than their heads—and Hungary possesses a great number of that class—would not hear of profitable speculation. "If it would benefit their Fatherland no other consideration was required; it would be degrading so noble an object to mix it up with such tradesmanlike

calculations." Széchenyi thought otherwise, and he felt assured that a profitable patriotism was the one by far the most likely to endure.

Count Széchenyi's first object was, to make the undertaking answer as a commercial speculation. This is a favourite theme in his writings; the constant test by which he examines a new scheme. I mean if of a nature to which it can properly be applied; for no one knows better how to sacrifice all pecuniary interest when necessary. He never recommends a thing until he knows that interest will back him, and he can then chink his full purse in his opponents' faces, and laugh them out of their prejudices. Of all he has done for Hungary, I know of nothing more useful than these demonstrations of the co-existence and often necessary connection of public and private interest.

During the earlier part of the last Diet, a strong opposition was formed in the Upper Chamber, chiefly under the guidance of Széchenyi, which contained many of the most wealthy and talented of the rising generation. From their moderation, their union, their knowledge of business, this party, though small in numbers, was acquiring so great an influence, that all the power of the court was employed to break it up. The Transylvanian magnates* were called away by the opening of their own Diet. Those in government employ were hastily recalled to their bureaux. This man received a place or a pension, another desired decoration, and hung dishonour at his button-hole, and if a third was too high for such poor bribery, he was recommended to travel, and accepted a passport to convey him from the sphere of his duty. Széchenyi, though deserted, was more difficult to dispose of, but that "every man has his price," is always the belief of an immoral government, and they found the means of withdrawing the patriot from the fulfilment of perhaps the higher duty, by offering him a much more arduous one. Széchenyi was made sole commissioner for improving the navigation of the Lower Danube, and almost before the ink was well dried on his commission, a thousand men were at work, current dams were constructed, canals were cut, roads were laid out, rocks were blown up, and the very Iron Gates themselves were threatened with destruction.

* A Transylvanian magnate enjoys the rights of a Hungarian, if he holds property in Hungary, which many of them do.

Széchenyi kept to his maxim—to leave the uncertain and follow the sure and practicable—and I recommend those who so loudly condemn his choice, to go to Orsova and see the result.

Since this time, though very far from neglecting his political duties, Széchenyi has taken a less active part in politics than was expected of him. Perhaps disgusted and alarmed by the violence of the less prudent; perhaps fearing that an active personal opposition, while it effected nothing, might impede much material good; perhaps confiding in the good intentions of government, or it may be reposing merely till a more favourable opportunity arises of urging on the Diet measures of justice to the peasant, and of encouragement to commerce: it is certain, from whatever cause, that he has withdrawn himself in some degree from active opposition. Looking at the whole tenor of Count Széchenyi's public life, we feel convinced that he has not acted without reflection, and probably not without good reason, in withdrawing from the political arena for a time; but he must not forget how much Hungary, how much Europe, expects of him.

When a man has once embarked on the stream of public life, he has no longer a right to disappoint the just expectations of the world. When such a man fails, the honest confidence, the high resolves, the purest aspirations of millions, are sacrificed. One feels a sickening at the heart, a contempt of virtue, a hatred of one's kind, when the man we have worshipped as the idol of our hopes, deceives us in the expectations we had formed of him.

The Hungarians, however, need not entertain such fears; whatever be the difference of opinion as to the means, no one can doubt the rectitude of Széchenyi's object. It cannot be denied that the support of high moral principles, the unflinching advocacy of just rights, and the unyielding defence of the injured and oppressed, are yet more important to the well-being of mankind, than the mere improvement of their material existence. But few in the Hungarian Diet have fulfilled these duties better than Széchenyi, while the other objects at which he has so industriously laboured, the detractors of his fame have entirely neglected.

Those who read Széchenyi's works, and know the reception which they met with, who are acquainted with the excessive national susceptibility of the Hungarians, and who recollect how just, and therefore how bitter, was the satire he directed against

them, will not suspect him of seeking popularity, except so far as it is necessary to the furtherance of his objects.

That Széchenyi has not attempted what he could not do, and what others have failed in doing when they attempt, is at home and abroad no uncommon subject of complaint against him. To me, it appears one of his greatest merits to have known his own powers, to have calculated accurately how far his means would enable him to go; to have reflected deeply on the practicability, as well as utility, of a scheme, before he proposed it for adoption, would seem just those qualities which best entitle a man to the confidence of a nation, and which, when united to high talents, necessarily make him the leader of a party. But Széchenyi's objects and hopes are best described by himself in concluding the "Hitel."

"The contents of my work will prove to all that I hate all extreme measures, all excesses; that I am a friend of moderation and harmony. Gladly would I see parties unite, and much more willingly would I obtain, by a middle path, the *possible good*, than vainly strive after that imaginary bliss which we may probably never know but in a better world. I cannot, like many of my countrymen, please myself with contemplating what is past. I must look forward. It troubles me but little to know what we once were; but it is of vital interest to me to know what with time we might, and what we probably shall, become. The past is beyond our control, the future is still within our grasp. Away then with future reminiscences! It is time that we bestir ourselves, and open a more glorious future to our fatherland. Many contend that Hungary has been: I love to think she yet will be."

Since the publication of the above Memoir by Mr. Paget, in 1839, the Count Széchenyi's time was entirely taken up in devising, with his usual talent and extraordinary exertion, plans of all kinds for the benefit and aggrandisement of his country. Love of his country was with him the one great passion; and no sacrifice of his time, comfort, or peace was too great to attain his object.

Amongst the many and useful projects for improving the condition of Hungary, was that of connecting the River Danube

with the River Theiss by a canal 118 miles in length, by this means opening a new source of conveyance of the produce of the interior up to Tokay. A regular Survey and Estimate of this important work, with the preparation of a Geological Map of the district, was entrusted to Mr. Clark, as well as the forming of a tunnel under the Festung or Fortification at Buda, through a calcareous rock, thereby cutting off a steep and circuitous route to a most frequented road; and, with the view of ultimately forming a communication with the proposed railway from Raab to Pesth, the tunnel was designed wide enough to admit of two carriages abreast, with a footpath on each side. This, with other works and valuable suggestions, was delayed in consequence of the political state of the country, and ultimately abandoned, during the Revolution, to some future period; but never to be carried out by the great and disinterested patriot who first proposed it. He predicted all that has since happened. That his country would be ruined, and Kossuth become Dictator. He did all in his power to counteract the terrible drama that followed, but his wise counsels were unheeded; his mind gave way, and Hungary now deplores the loss of the advice and able assistance of Count Stephen Széchenyi.

REPORT OF THE BAU-DIRECTION

ON THE

STATE OF THE DANUBE IN 1832.

TOPOGRAPHICAL DESCRIPTION OF THE COURSE OF THE DANUBE, FROM THE LOWER POINT OF THE ISLAND OF ST. ANDREW, ABOVE OFEN AND PESTH, TO THE POWDER-MAGAZINE BELOW OFEN.

TRANSLATED FROM THE GERMAN.

After the junction of the two arms of the Danube, which form the island of St. Andrew, by Bekas Megyer to the right, and by Kaposztase Megyer to the left, the river is continually intersected by several considerable islands and sandbanks, viz., by the Island of Pesth, the Great Minor Island, "Grosse, Kleine Insel," Margaret's Island, and Dyer's Island. After having collected its strength below Margaret's Island, it firstly concentrates in the vicinity of the Ponton, and remaining in its full force to the extent of several hundred fathoms, soon disperses itself in its rapidly extended course, and divides into the two arms of the Danube, by which the well-known Island of Csepel is surrounded; the principal arm taking its course towards Promontori; the other arm being the Soroksara Danube.

The breadth of the river increases towards the upper parts, where it is divided by the islands, to the extent of from 400 to 500 fathoms and upwards, exclusive of the islands. After its juncture below the Island of St. Margaret, at G K in the Profile, it is from 480 to 490 fathoms broad, but afterwards decreases to 250 fathoms in breadth; next the Ponton it is from 220 to 230 fathoms, and it finally decreases to only 160 fathoms; this is at

C D in the Profile. Near the Blocksbaade, at L M in the Profile, it attains a breadth of 195 fathoms, whence it suddenly spreads to a breadth of 530 fathoms; it continues thus broad to the Island of Csepel, the two streams conjointly being 500 fathoms broad.

It cannot be passed over without observation, that the breadth of the river varies, one part compared with another, to the extent of 300 or 400 fathoms. The breadth of the river, or, more properly speaking, the natural boundary of the same within its limits, commencing from the Ponton, down to the Blocksbaade, being the narrowest portion, scarcely differs, as will be seen by the cross profiles, A B, E F, G H, C D, L M.

The depths of the river are no less surprisingly variable than its breadths, for in the upper range, where it is divided by the islands, its depth changes with the lowest ebb of the water, from five to ten feet only, usually, and seldom to twelve feet; in its lower range, from eight to, at most, fifteen feet, while in its concentrated course, it is from thirteen, fourteen, to at most, thirty-one feet deep.

On inspection of the chart of the locality, in the first instance, the impediment to the escape of the water seems to occur between the profiles E F, and L M, viz., in the vicinity of the mountain of St. Gerhard; but when recourse is had to the profile of lengths, and the cross profiles, and we consider at the same time, that the production of water depends on three dimensions, viz., breadth, depth, and velocity, it follows that the breadth is the most considerable dimension compared with the others, but that the other two, together, are greater: consequently, that the narrow parts of the river were calculated to accelerate much more water than the profiles, upwards and downwards, which are considerably broader but much shallower, if the shallow parts of the river occasioned by its excessive breadth, were not an impediment to the flowing.

For, according to the profile of lengths, there exists a dead water in the depths situated between the profiles, *a b* and *t u*, which is proved by the annexed calculation of the consumption of water. Thus, for instance, leaving the irregular profiles G H, L M, S T, U V, out of the question, and only comparing the cross profiles C D, E F, *c d*, with each other, which are quite sufficient for calculating the different states of the water as to its ebb and flood, the products of the water will be found to vary exceedingly, if in the calculation the water contained in the depths of the Danube

which contributes nothing to its flowing, be overlooked, when, on the contrary, a very near approximate product of all three degrees, viz., the lowest, middle, and highest, is obtained, if in the calculation, the dead water with the assistance of the profile of the lengths be taken into consideration. The rule, theorctically demonstrated, by which a channel can be constructed, most favourably to the flow of the water—viz., by having the smallest possible circumference, in order that its adhesion and friction, which retard the flow, may be diminished—is nearest answered by the space next the profile C D, as is evident from a comparison of the cross profiles.

From the form of the channel of the Danube at present briefly described, the very dangerous visitations to which both the capitals are exposed, accruing from the ice, at the time of high water, will be fully apparent; for where the river suffers a great diminution of its rapidity, where it deviates from its concentrated course near the Blocksberg, into its bed which is suddenly extended, and, with it, the power of impelling forward masses of ice also, just then, the course of the stream varies, on account of the sand-banks situated on the lower side, from the right shore verging towards the left, and, as appears from the annexed map of the breaking up of the ice in the year 1815, causes the ice to flow into heaps on those very sandbanks situated at the lower end of the city of Ofen; and this continues to place more obstacles to its course, but, especially, below the Camp Laager Hospital on the Pesth side, where the masses of ice are accumulated by the stream in the shallow Soroksarer part of the river; and in the upper point of the Island of Csepel a new obstacle forms itself, in consequence of which, its power, already diminished, is further reduced, as the curve of the river likewise becomes further extended in consequence of the accumulation or heaping up of the sand and ice; it is therefore evident that an obstruction of the masses of ice must follow, which impedes its breaking-up, and, very frequently, obstructs even the course of the river, which gives rise to a re-percussion, and thereby occasions the surface of the water to rise higher than usual; besides this, the Soroksarer arm of the Danube, which, according to computation, in its middle state, is capable of carrying off nearly a fourth part of the entire quantity, becomes completely blocked up by the heapings of the ice, occurring one after another

during the course of the winter, and consequently, the whole body of water is forced violently into the main arm, the profile of which is only formed for the product of water usually flowing through the same.

According to existing observation, the surface of the water rises, in such an extraordinary case, from 6 to 8 feet higher than the high water at any period of the summer, which, according to observations made at Ofen-Pegel, is hardly 16 feet above "zero;" whereas, the rise of the water, occasioned by the ice in 1830, attained to the height of 22 feet above zero, and that of 1775 reached the height of 24·2 above zero, being the highest within the memory of the inhabitants,* and which has been transmitted, with considerable care to posterity, by the construction of tables of marble immured in the walls of the thirtieth royal public edifice in Ofen, situated immediately next to the water, or "Wasserstadt," and also in that part of the city inhabited by the Raitzes, on the house of Dobrosklaai.

This extreme high water covered both shores, the latter being only from 19 to 21 feet above zero, whilst the water of 1775, as before stated, rose to the height of 24·2 above zero; even the wall, serving as a barrier at Pesth, against the inroads of the water, is only constructed $22\frac{1}{2}$ feet above zero. It is, therefore, easy to form an idea of the devastation which both capitals must be exposed to in a similar case, but more particularly the city of Pesth, a great part of which, containing the most valuable goods and merchandize, is situated several feet below the level of the high water occasioned by the ice, and remains exposed to this extraordinary peril, devoid of all protection.

The Act of Inquiry instituted on the part of the Royal Hungarian Supreme Direction of Buildings (sub No. 810, 1832), in the royal free city of Ofen, confirms the misfortunes, universally

* As the word "zero" occurs several times in the course of the work, it will be proper here to give an explanation of its meaning. Several years ago, on the breaking up of the ice, it met with an obstruction in the shallow part of the river above Pesth, and stopped there. The ice, in the meantime, began to accumulate from above, until it formed a partial dam, which obstructed the course of the river, and caused it to fall several feet at Pesth. This low water (which lasted only a few hours) was marked as "zero;" not for any practical purpose, but merely to notify the lowest water ever known in the Danube. This, as will be seen on inspection of the Plans, &c., was used as the datum line in the construction of the bridge. This Report was published in 1832, since which time a flood considerably higher than that of 1775 has occurred, viz., in 1838, as will be seen on reference to the plates.

known and handed down by tradition, caused by the high water occasioned by the ice in the year 1775, according to which a considerable number of houses are stated to have been thrown down, and a great many persons perished in the inundation.

According to the said Act of Inquiry, in the year 1775, the blocks of ice were an ell and a half thick, and piled up in many places above 12 feet in height.

When the water is not so high, the Waitzner-street dam forms an effectual source of defence to the city of Pesth, as that dam cuts exactly through the low grounds by which the high water, beginning at the upper end of the city, would effect its escape through the Lakefield gardens into the town suburbs, Theréze, Joseph, and Francis, and would disgorge itself into the Danube by means of the Wood-dam, by which the lower part of these low grounds is protected from the waters of the Danube.

In the aforesaid low grounds, traversing the city, which, from traces still discernible, appears at one time to have formed an arm of the Danube, a principal divisional channel is cut, and from the dam a canal under ground has been constructed, by means of which the water from the ground, from rain or snow, is conveyed out of the city into the river, at the same time the high water is prevented from making its way into the city.

It is to be attributed to the Waitzner-street dam—which, by dint of continual watching, and being kept heaped up, was enabled to prevent the high water of 1830, occasioned by the ice, from making its way to the low grounds, that this high water was productive of very trifling damage compared with the devastation which occurred during the year 1775, and that merely by waters from the ground in the capital of Pesth; likewise on the Ofen (or Buda) side, the high water of 1830 was, comparatively, much less destructive than that of 1775, for the reason that, since that catastrophe, the foundations of the houses have been considerably raised.

It results from what has been already stated, that the high water in summer is productive of no damage to either of the capitals, whereas the extraordinary high water which is produced by the stoppage of the ice, involves them, on the contrary, in the greatest peril; and this stoppage is to be ascribed to the present form of the bed of the river—that is to say, from the immoderate breadth, and obstruction of the channel by sand.

From this may be drawn the inference, that if the breadth of the stream of the Danube, from the Blocksburg to the powder-magazine guard-house, below which the river seems to have a regular bed to a considerable extent (as to which, however, the practical survey still remains to be taken) were lessened, the main cause of the danger of the stoppage of the ice would be removed, and would be productive of the most beneficial results to both the royal capitals: also by the construction of a permanent bridge; and for this reason, it might be well worthy the attention of both the royal free capitals, and also of the Bridge Building Association.

The descent found by the level, in the state of the water, three feet five inches above the lowest ebb, varies from the Bekas Megyer frontier to the Ponton, from three to six lines per 100 Vienna fathoms.

From the Ponton downwards to the Blocksburg, the descent is only two-and-a-half to three lines per 100 fathoms; whence, downwards to the extreme point of the operation, viz., to the Powder Magazine, the descent is eight lines per 100 fathoms. The total descent from the lower point of St. Andrew's Island, above Ofen and Pesth, to the Powder Magazine below Ofen, a distance of 8800 feet, amounts, in the state of the water quoted, to 3′ 6″ 9‴, which gives an average of 5·8 lines per one hundred fathoms.

This inconsiderable fall from the Ponton downwards indicates the existence of an impediment below, which opposes the flowing of the water, and, consequently, the lowering of the surface.

Although the extent below the Ponton has the least descent, yet the greatest velocity was found in the same, as is proved by the cross profiles, and the annexed table of the consumption of water, which is only to be ascribed to the contracted force of the stream, on account of the regularity of the channel, for with the descent of the river, under similar circumstances, the velocity increases, because that is the operative cause, unless it be retarded by the increased friction and adhesion consequent on the larger circumference of the bed.

The river here contains small "schotter" and river-sand, here and there intermixed with mud and silt.

The bottom of the river is firm throughout; near the St. Gerhard's Mountain from the cross profile C D to below L M,

the rocks extend from the mountains to the middle of the river, but, very fortunately, they are situated so deep as neither to impede the flow of the stream nor the navigation of the river.

From the upper end of the Market of Old Ofen to the Ponton, the shores consist of street-earth; from two to fourteen feet, there is deep, slimy mud or loose earth; then follows a layer of clay, and this again is succeeded by "schotter."

In the same extent, but more distant from the shore, the loose earth attains a depth of thirteen feet; after which follows a stratum of blue loam or potter's clay, and under this, again, yellow clay.

In the vicinity of the Ponton, the ground above consists of street-earth and rubbish to a depth of fifteen feet; then loam succeeds, and, finally, the rocks which extend from the Mountain of St. Gerhard into the river.

From the extremity of the city of Ofen to the Powder Magazine, there is loose garden earth to a depth of twelve feet; then follows a stratum of clay, three feet thick, and underneath another of "schotter."

Along the whole range of the city of Pesth, after a sandy street-earth to a depth of two feet, follows a loose earth mixed with slime and sand to a depth of fourteen feet, afterwards a stratum of "schotter" eight feet thick, under which there is river sand, two feet thick, and this is followed by clay-earth.

The elevations of the shores and grounds, made apparent by the profile of the lengths, expressed as they are by marks "bottom" in the map of the locality: those only—above the lowest water—of the mountain of St. Gerhard and the fortress of Ofen, are given:—

	Feet.	Inches.
The Mountain of St. Gerhard, near the Observatory, is	432	0
The Mountain of the Fortress, in the Royal Palace Court, is	186	3
The Mountain of the Fortress, St. George's Place	211	4
The Mountain of the Fortress, Trinity Place	230	2
The Mountain of the Fortress near the Garrison Church	219	3

All above the lowest water-mark, or "zero."

AS RELATES TO THE NAVIGATION.

The course upwards, or the passage downwards, is free above the island of St. Margaret in the main arm, afterwards on the side of the island of St. Margaret in the Pesth arm, further below the mountain of St. Gerhard in the whole breadth of the Danube, and then ranging with the course of the river, doubling the sand-banks, into the main arm of the Danube towards the Promontori.

The counter-passage goes on without impediment the whole extent from the Powder Magazine to the point of the island of St. Andrew on the right shore, when the water is high; but when it is low, the course of the navigation must be round the sand-banks, Kopaski and Hasenlauf, situated below the St. Gerhard mountain, with great force and loss of time. The same in Old Ofen, in order to avoid the shallow arm of the Danube, they must tack and stand for the great island, and back towards the right shore. The Soroksarer arm is only navigable by the inhabitants on its banks in small craft, and even the navigation thus carried on is interrupted when the water is low.

According to 5 B of the Act of Inquiry at Ofen, the largest ship-mill,* from top to bottom, is 3 fathoms high, and draws 2 feet 6 in. of water.

	Feet.	Inches.
The height of the largest mill is	15	6
The greatest breadth is 8 fathoms	48	0
The greatest length, 9½ fathoms	57	0
According to 7 B, the height of the largest hard-ship is .	21	0
The height of the greatest soft-ship is	27	0
According to 6 B, the height of the greatest soft-ship is .	18	0

According to 7 B, the largest empty oak-built vessel immerges 2 feet deep, when laden 6½, at most 7 feet.

The breadth of one of the largest Danube vessels is 3° 4′, at most 4° 1′ = 25 feet.

According to 7 B the largest Danube vessel, without her helm or rudder, is 27° to 28°; according to 6 B up to 32° in length.

* These ship-mills are in use on the Danube for grinding corn, and are worked by the stream.

The measurement of the rudder outwards, from the extremity of the vessel, is $2\frac{1}{2}$ fathoms, including the tiller as much as $7\frac{1}{2}$ fathoms.

However, the height of the vessels in 7 B seems to be over-estimated, as, according to the examination actually effected, the height of the vessel of largest dimensions now riding here at anchor is only 14 feet 6 in., which agrees more with 6 B, that the largest soft-vessel, from bottom to top, is at most only 18 feet high.

For the Royal Hungarian Supreme Building-Direction,
Ofen, the *5th July*, 1832.

Six years after the date of the above Report, viz., in 1838, a flood again occurred, which, in the height to which the water rose, and the damage caused by it, was without precedent in the traditions of Pesth. The ice in the river, near the piers of the proposed bridge, was six feet thick on the Ofen side, and ten feet on the Pesth side, in the beginning of February—a great part of this thickness, however, consisted of congealed snow. In this state it continued until the morning of the 9th of March, when a movement of the ice took place across the whole breadth of the river, and for about 350 yards in length,—the whole moving in one solid mass, where it remained until the afternoon of the 13th, when a similar movement took place for about 400 yards in length. It remained here for about three hours, when a general break-up commenced. The ice, however, stuck fast in the narrow section of the river opposite the Observatory, which caused so rapid a rise of the water, that by eleven o'clock in the night a great part of the town was inundated. About two o'clock in the afternoon of the 14th, the ice moved from the narrow part of the Channel, opposite the Observatory, but again stuck in the shoals, where the river divides at the head of the Island of Csepel, causing the water to rise to the extraordinary height of 29 feet 5 inches above zero, on the morning of the 16th of March, at which level it stood for a few hours, when it rapidly commenced lowering; and, forty-eight hours

afterwards, was down to 20 feet 10 inches above zero; but, although the highest water lasted but for a few hours, the damage sustained was enormous. A great part of Buda, and two-thirds of Pesth, were destroyed, and a great many lives lost.

The Count Széchenyi was indefatigable in his efforts to alleviate the distress caused by this terrible catastrophe. The Baron Sina contributed 4000*l.*, and likewise interested himself in the most praiseworthy manner to afford help to the sufferers.

REPORT OF W. TIERNEY CLARK ON THE PROPOSED BRIDGE AT PESTH, 1837.

VIENNA, 26*th September*, 1837.

SIR,

I think it necessary, having been chosen by you to conduct the building of a permanent communication between the towns of Buda and Pesth, to call your attention to those points of difficulty which have come under my consideration.

The intercourse between Buda and Pesth is, at present, very great, and, no doubt, will greatly increase; it is, therefore, necessary for the anticipated traffic, that the communication should be of a safe and solid construction, and I am sure that you would not, in your high position, connect your name with any enterprise promising only a temporary utility and splendour; nor would I, after the various works which I have completed, undertake the conducting of a work but upon the most safe and stable construction, and calculated to last for many centuries.

By the preparatory works of the Directory for Public Buildings, and which was communicated to me by Counts Andrasy and Széchenyi, in the year 1832, and since which I have devoted much of my time to the consideration of the subject, and from the information which I have obtained during my visit here in 1834, and my late investigation at your request, I am of opinion that the description of bridge best adapted for either of the situations represented by the various plans and sections, for forming a permanent communication between Pesth and Buda, is a Chain Suspension Bridge, as the limited number of piers required will oppose much less obstruction to the flow of the water and ice than either a stone or cast-iron bridge. And this opinion I communicated in a report of the 10th of November, 1832, to Counts Andrasy and Széchenyi, and since my late examination of the locale, I am more confirmed in that opinion than before.

A bridge with stone arches could be built to cross the Danube at either of the situations represented by the plans and sections; but it would be attended with great risk, owing to the consequent number of piers which would be exposed to the flow of the water

and ice; so that, if the piers themselves did not endanger its completion, there can be no doubt whatever that their number and size would greatly enhance the danger of inundation. In addition to the above difficulty, it is not possible to obtain a good approach on the Buda side, without the destruction of considerable private property.

A cast-iron bridge, supported on stone piers, would be preferable to a stone bridge, inasmuch as a less number of piers would be necessary, consequently there would be less obstruction to the flow of water and ice; but it would be subject to the same inconvenience on the Buda side for an approach. But by far the greatest difficulty to encounter in the building of a cast-iron bridge would be that of procuring the necessary castings and workmanship, both of which must be of the very best description, and the parts of such large dimensions, that the transport would be next to impracticable if cast in England, which I am inclined to think would be requisite; as, from the best information I have been able to obtain, there is not sufficient experience and means on the Continent to undertake such a work.

A wooden bridge could be built on stone piers, as in America; but it would be, from the number of piers requisite for its construction, extremely objectionable; and as the entire of its superstructure would be composed of timber, its durability could not be permanent, and its annual reparation considerable, which would by no means answer the purpose you and the legislature of Hungary have in view; and the more I have investigated this subject, the more I am convinced that a chain suspension bridge, under all the existing circumstances, is the best adapted to form a communication between Buda and Pesth; and from past experience I am convinced that such a bridge could be built to answer the purpose with perfect security; but it is necessary to call your attention that no expense must be spared to render it perfect in all its parts. It is not necessary for me to trouble you with the number of suspension bridges that have failed in France; but it is incumbent on me to explain, as briefly as possible, that they have failed principally from want of proper knowledge and experience, so necessary to ensure stability and security; and, in general, the money allowed for such works has not been sufficient to render them permanent structures. On the other hand, the

suspension bridges built in England, under the direction of the late Mr. Telford and myself, have stood unimpaired up to the present time, and as firm as on the day they were first opened, and no time can be anticipated for their decay. But suspension bridges can be constructed of greater strength than those now in existence.

Next to the practicability, the amount of capital is to be taken into consideration, requisite for the building such a bridge; but on this subject it is difficult to give you any certain information, as so much depends upon circumstances over which there is no control; for a favourable winter during the time of building may reduce the cost, and an unfavourable one greatly enhance it.

The iron and stone work may be calculated nearly; but as the bed of the river, and the banks on each side, are chiefly composed of sand and clay, and the depth of the water varies from its ordinary state to a rise above it of twenty-five feet, it is therefore quite impossible to obtain a good and certain foundation without the aid of coffer-dams for the piers and the abutments. If there was any certainty that the season would prove to be dry, the coffer-dams could be made for one-half the sum necessary to contend against a season abundant in water; but, as this cannot be foreseen, it is necessary to contend against extreme contingencies; and the time from spring to autumn, even in a mild season, will be scarcely sufficient for finishing one coffer-dam in the river; but if the following winter be mild, the coffer-dam may remain safe, and the pier and masonry greatly advanced; but if, on the contrary, the winter should be severe, and produce large masses of ice in the river, the coffer-dam may receive injury, the reparation of which may be costly, and money and time lost; and with structures of this kind, that yield no income until quite finished, it is necessary for you to take this most particularly into your calculations. But if several severe winters follow each other, as I understand is often the case, there are no data for me to found a calculation upon with any degree of certainty. That you may have some idea of the cost, to found your calculations upon, it is here necessary to observe that the estimates furnished to Counts Andrasy and Széchenyi in 1832, were for bridges of the strength now in use in England; but since I have seen the situation, I am of opinion that the bridge should be made stronger than any now

in use: and I think, under all the circumstances, that a good and substantial bridge could be built, at the point shown on the accompanying plan, at a cost not exceeding 300,000*l.*

In respect to the iron-work, I am most decidedly of opinion that it cannot be manufactured on the Continent with that degree of soundness and accuracy so absolutely essential to ensure security, added to which, it will require constant personal attention of myself or agents, during the progress of manufacture and proof.

I have examined several stone quarries, and the result is that the Wolfsthal and the stone of Csobánk will answer the purpose required.

The situation which I recommend for the site of the proposed bridge will be seen from the accompanying plan, and although I have examined the other situations marked on the plan, and have no doubt that a bridge could be erected at either of the sites; yet that which I have fixed upon is the best, in my opinion, because on the Buda side it will be seen, on referring to the plan, that the fortress-hill is so far from the river, and the ground, both longitudinally and transversely, is so favourable for an approach as to require very little alteration of the present carriage-way to make the ascent of the bridge very easy. On the Pesth side also, the ground is very favourable, and an ascent equal to that on the Buda side can be obtained without interfering with any buildings, and the bridge would be better situated in this spot for the general convenience of the public.

A foot-bridge could be erected of one span as marked on the plan, and the cost of it would be about 120,000*l.*

During my stay at Pesth, great anxiety was expressed by many persons that the piers in the river could not be made to stand against the ice, and that their size would cause inundations; and that it would be absolutely necessary that myself, or some competent person appointed by me, should pass a winter on the spot, in order to observe the breaking up of the ice; but the observations which I have had made at St. Petersburg and Sweden relieve me from the apprehensions I have heard so strongly expressed; and I am confident that the produce of ice in the Danube will never affect the piers; and as regards the apprehensions expressed that the piers will cause inundations, these are also futile; for as the same sectional area will be preserved at the proposed bridge as

there is at present at the narrowest section of the river, there can be no danger whatever. I also heard during my stay at Pesth, that it was intended to regulate the banks of the river, and there can be no doubt that they require it very much, and the keeping and upholding of the banks should be under proper directions, and the police should be employed to prevent dirt and other rubbish being thrown into the river, which, being washed down when a rise of water occurs, lodges on the Island of Csepel, and thus increases its size, which has been going on for centuries, and, no doubt, adds to the risk of inundations; and some coercive measure should be enforced to prevent, as much as possible, farther accumulation; but provided this regulation takes place, it will in no wise interfere with the works of the proposed bridge, as they may proceed together or separately.

On my return to England, I purpose sending to you, on or before the 10th day of November next, a plan and section of the proposed bridge, showing the situation of the piers, with the inclination or rise of the road, or approach to the bridge, on each side of the river. And I have no doubt whatever that in case the works be done according to my design (of which I shall take care), that it will answer the intended purpose, and be a long and lasting edifice.

(Signed) W. TIERNEY CLARK.

To the Baron Sina.

CHAPTER I.

SOME ACCOUNT OF THE PROGRESS OF THE WORKS.

1839—1845.

1839. In the month of May, 1839, the royal assent was given to the project of connecting the cities of Buda and Pesth by a suspension bridge.

The Baron Sina having entrusted the entire execution of the bridge and works to Mr. Tierney Clark, with power to choose his own English staff of assistants, the following were chosen to conduct the several departments specified below, viz. :—

W. TIERNEY CLARK, F.R.S., Engineer-in-Chief.
ADAM CLARKE, Resident Engineer.
JAMES TEASDALE, General Clerk of the Works, Superintendant of Pile-driving, and (in consequence of the death of W. WARDROBE) Superintendant of Masons' Work also.
BLAND W. CROKER, Superintendant of the Chain-bars, made by Messrs. HOWARD & RAVENHILL, of the King and Queen Iron-Works, Rotherhithe, London.

The following is a Journal of the proceedings :—

In the September following, Mr. Tierney Clark had two trial piles driven through the bed of the river into the clay beneath ; the piles were of fir, but differing as to hardness, and the following were found to be the results of the experiment :—

The first pile was driven 20 feet 6 in., and the second 22 feet below zero, and therefore 4 feet into the clay substratum.

On leaving off driving, it took 30 blows with the monkey, with a fall of 25 feet to drive the first and hardest timber pile $\frac{3}{16}$ths of an inch.

The same number of blows with the same fall drove the second and softest timber pile barely $\frac{1}{8}$th of an inch.

From 12 to 16 blows were sufficient to upset the top of the first

pile, so as to entirely destroy the effect of the blows, until the damaged part was cut off, and the pile relooped.

From five to six blows were sufficient to produce the same effect on the second pile.

The outside of both piles was splintered and shaken a little; the first and hardest rather the most. The results of the driving, however, were considered satisfactory.

During the following autumn, the space required for the fixture-pier on the Pesth side—being that with which it was proposed to commence—was enclosed, and the excavation of the ground commenced. About 8924 cubic yards were removed, part of which was used to level the building-yard, which was very uneven, and to raise the floors of the sheds, magazines, and workshops, about a foot above the level of the rest of the yard, and part to fill up and level the space below the site of the coffer-dam where the high part of the shore receded very suddenly, by which a useful level space was gained, and likewise formed a part of the approach to the wharf. The position of the coffer-dam and wharf for this, called No. 1 pier, will be seen on reference to the map.

Before December, the whole of the space necessary for the coffer-dam, work-yard, &c., was enclosed by a strong fence 8 feet high, with proper entrance-gates, a magazine for stores and materials, and a small brick-house containing an office, rooms for watchmen, &c.

Shops for smiths, carpenters, and others, and a wharf were put in hand in the autumn, and finished during the winter and following spring.

1840. As the quantity of timber required in the construction of the coffer-dams would be enormous, the first endeavour was to procure the transmission of a sufficient quantity at stated periods, and this, from the great distance of the forests and bad state of the roads in almost all seasons, was attended with no little difficulty.

The fir-timber had to be brought from Bavaria and the forests of Upper Austria, the oak from Sclavonia, and the larch from the Styrian mountains. The Sclavonian oak is so remarkable for its size and magnificent appearance, that a short description of it will perhaps be acceptable.

Those trees near Podgeize, in the vicinity of the Save, which is the boundary between Turkey and Sclavonia, are more especially

celebrated for their superior height, grandeur, and quality as timber, although the forests, interspersed over Sclavonia, produce trees nearly as fine. Many of them rise to a height of 50, 60, and even 70 feet, without a single branch or knot, perfectly straight like some tall column, for 80 feet and upwards, when the top branches begin to spread out. The most curious circumstance about these trees is their small diameter at the root compared with their height, and diameter at top; some at 70 feet from the ground being 23 to 26 inches, while at the base their diameter is not more than from 39 to 48 inches.

Der Frauben Eiche (grape oak) is so called from the manner in which the acorns are clustered together, at the end of a very short and scarcely perceptible stem on the young branches. The acorns are small, short, and egg-shaped, and provided with a fine thorn at the top. When ripe, they are of a dark brown colour. The fruit-cups resemble leather, with a rough scaly skin, and are clustered together from two to four and even from six to twelve, on one stem.

The bark on the young trees is smooth, and of an olive-green colour; when grown, rough and of a brownish-grey; when aged, ash-grey, and covered with deep and regular furrows, the interior of a rusty red.

The Stiel oak, so called from the long stem or stalk on which the acorn hangs. The acorns are large, roller-shaped and rounded, with their points blunt, and when ripe of a leather-brown colour. The fruit-cup is woody, and provided with a fine hair, particularly round the edges.

The wood is heavy, hard, and tough, and the fibre fine. When young the wood is white, but when full-grown it becomes brown. Towards the heart this wood is much tougher, and less liable to splinter than the "grape oak."

The weight of the Sclavonian oak is, generally, about 55 to 60 pounds per foot cube, and some was found which *sunk* in the water. When perfectly dry, it loses about one-third of its weight, being then about 36 to 40 pounds per foot cube.

This timber was delivered at the works at Pesth, in lengths of from 40 to 80 feet, and 15 inches square, at the rate of from 50 kreutzers to 1 florin per foot run.

The manner in which large timber is usually got out of the forests is, in the depth of winter on sledges, when the ground is

covered with snow and frozen, or in the height of summer when the marsh lands are dry. The whole, or nearly the whole, of the forests are inundated in the spring, when the snow melts on the mountains.

It being found impossible to square the timber with any accuracy in the forests, this was obliged to be deferred until its arrival at Pesth. The whole of the Sclavonian peasantry use the axe extremely well, and this proved of great advantage, as 300 or 400 men could at any time be procured at a few days' notice. The distance from the forests to Pesth is about 160 miles.

The excavation for the retaining pier was finished about the middle of March, 1840. The ground was taken out to a depth of 3 feet 6 inches above zero, which was as low as the state of the Danube would allow, with the use of pumps. (Plates III. and V.)

In the month of April, Mr. Adam Clarke, the resident engineer, by direction of Mr. Tierney Clark, visited the iron-foundries of Styria, in order to ascertain what amount of iron-work could be obtained in the country, without having recourse to the great delay and expense attending its manufacture in England. He found their workmanship tolerably good, much better, in fact, than was expected; and, in future, it was decided, all the shoes, rings, bolts, &c., should be made there. A quantity of pile-shoes, besides other iron-work, had been previously shipped, viâ Trieste from England.

The following were the prices of iron-work, delivered at Pesth, from the foundries of Styria:—

Common-pointed shoes, 22 florins; broad bevil shoes, 24 florins.
Driving-hoops, bolts, plates, &c., 18 florins per Vienna cwt.*
Bar-iron, according to quality, from 9 to 13 florins per centner.
Cast-iron, from 9 florins 20 kreutzers (which was the price of the road-way beams) up to 15 florins, the price of the truss-columns, and of the ornamental sockets for the trussing of the platforms.

Mr. Adam Clarke from Styria proceeded to Upper Austria, from whence the fir timber had been ordered. He found it exceedingly good, close-grained, well-grown, and free from knots, being nearly the same, both in appearance and quality, as the *first* of the

* The Vienna cwt. is about five-sixths of the English cwt.

trial-piles, which were driven by order of Mr. Tierney Clark in the previous year.

A great quantity of timber was cut and squared ready for the first dam, and only waiting to be conveyed to the Danube, but this could not be accomplished until the melting of the snow, as the whole of it had to be floated to the river by small streams which were at that time nearly dry, and it was not until the 24th of May that the first ship-load arrived at the works.

The whole of the piles and other timber required for No. 1 dam, with the exception of the two inner rows of oak piles, were contracted for to be delivered at Pesth for the sum of 24,000 florins (2400*l.* sterling).

Mr. A. Clarke likewise examined a large extent of forest country, between Linz and Salsburg, for the purpose of ascertaining whether timber of sufficient quantities, and the requisite dimensions, could be obtained, in case it were decided, from the experience of the ensuing summer, to construct the remaining three coffer-dams entirely of fir. No difficulty was anticipated, provided proper time was allowed, in providing all the timber necessary, with the exception of the 70-feet piles, which could be obtained only in Selavonia.

Arrangements having been made for the requisite supply of timber, and the manufacture of the iron-work necessary, the next difficulty that arose was to provide for the great quantity of stone that would be required in the next and following years.

Several quarries in Hungary and Austria were examined in 1838, by Mr. Tierney Clark, who reported on their relative merit to the Baron S. G. Sina and the Count S. Széchenyi; among those he considered likely to afford stone of good quality, and of sufficient dimensions, may be mentioned those of Wolfsthal and Mauthausen for granite, Soskut and Waitzen for soft and hard stone. The stone in all these quarries was good, but the tools and apparatus of the proprietors so imperfect, that it was found necessary to send for English quarrymen and workmen to superintend the working of them, and to teach the natives to make use of proper tools, without which it would have been hopeless to attempt to raise the large blocks required, some of the blocks being 10 feet long, and 10 to 12 tons weight. The granite was obtained from Mauthausen, but the great distance from the works formed a serious drawback,

being no less than 270 miles—it was brought down in barges to Pesth; the barges as they arrived were purchased by the Bridge Direction; some were broken up, and the remainder kept for the purpose of supporting the platform during the process of raising the chains.

During the spring, the piles for No. 1 dam were squared and trimmed perfectly true, in readiness for the contractor for the dam, Mr. George Burge of Herne Bay, whose agent arrived on the 18th of July, together with his clerk of the works, and seventeen workmen: this number, however, proved insufficient, for the natives were found to be so inefficient at pile-driving, that it was requisite to send immediately to England for more men—two English workmen being found absolutely necessary to each pile-engine.

About the 20th of July the staging for the first dam was commenced.

On the 28th of July, 1840, the first pile was pitched for No. 1 dam.

The piles at the head of the dam drove tolerably well, but those forming the returns much stiffer, from the greater depth of material. Some of the piles were broken, and obliged to be redrawn, in consequence of which it was determined to try the experiment of driving the piles in bays, and to dredge out the gravel in front of them, at the same time driving. This plan was found to succeed perfectly.

Mr. Tierney Clark arrived at Pesth on the 4th of September, 1840, and from the results of experiments made during his stay, came to the conclusion that the best Austrian fir was quite equal in quality to oak. It was therefore decided that fir of the best description should in future be used instead of oak.

Mr. Clark found the pile-shoes and other iron-work furnished by the Styrian manufacturer, Mr. Sesler, satisfactory: but it was necessary to order the iron rings for the piles to be made of the very best Styrian iron, as the Hungarian iron is by no means to be depended on, owing to its defective preparation.

A crane was by this time fixed for unloading the timber, which began to arrive in considerable quantities; and the wharf was extended up to the site of the coffer-dam, whereby much of the expense and time occupied in removal was saved.

Considerable difficulty was experienced in driving the piles

through the hard bed of gravel which overlies the clay, after they had been got down to that stratum with comparative ease by the use of the plan mentioned; this gravel being of such compactness as to shake the piles very considerably, and screw-glands were found necessary to prevent them splitting. Many of the piles had to be withdrawn, and it was found on examination that the shoes had been displaced. To remedy this, the shoes were riveted on, in addition to the nails, and for the future the piles were ordered longer than absolutely required, to allow for re-heading.

A twenty-five horse engine with pumps was at this time making in England, but it was found that at the back of No. 1 dam, where the engine was to be fixed, there was a running quicksand; it became necessary, in consequence, to extend the dam all round, in order to keep the shifting sand in its proper position.

It having been arranged that Nos. 2 and 4 dams should be commenced the following spring, the requisite iron and timber was ordered immediately, as well as eighty pile engines.

An ice-breaker or dolphin was also constructed during the latter part of the autumn, a little above the site for No. 2 dam, or that for the tower nearest the Pesth shore; this dolphin, which served as a protection against the ice, rafts, &c., was constructed at this time, so that a means might be afforded of judging of the actual force of the ice during the winter ensuing; and the event proved that its construction was most fortunate, as the winter of 1840-41 was unusually severe.

After the excavation of the gravel as detailed above, from $1\frac{1}{2}$ to 2 days sufficed to drive the bay-piles: the gravel was dredged out to within 5 or 6 feet of the clay; and after the piles had been driven home, the operation of dredging out the gravel was continued all round the dam, as well as at the returns, and the result proved most satisfactory.

Some experiments were made with the clay from Alt-Ofen, as to its capability for making good puddle, for filling in between the rows of piles, shown on the sections of the dams (Plates XIV. and XV., &c.). A specimen sunk in the Danube, without any admixture of gravel, soon got as soft as mud; while some that had been mixed with about a third clean gravel, had set quite solid.

The piles for the dolphin above the site of No. 2 coffer-dam, drove very well; the time of driving generally, including pitching,

was $1\frac{1}{4}$ day. Several of them were driven 7 feet into the clay and took $1\frac{1}{2}$ day to get down, going at last $\frac{1}{4}$ of an inch at a blow, with a 15-feet fall; the oak piles could not be got down deeper than this, as they began to split, and no fir piles long enough could just then be obtained; the piles drove much better and penetrated deeper than those for No. 1 dam, in consequence of the gravel being of a very loose and yielding nature, whilst that at No. 1 dam was almost as compact as rock, and gave as much trouble as the clay itself.

In the month of December the dolphin was finished, and no sooner was it completed than an extremely hard frost set in, and early in that month the Danube was covered with masses of floating ice, some of which struck it with tremendous force; being, however, well bolted together and secured in the strongest manner, no damage was sustained.

No. 1 coffer-dam was likewise not at all injured by the violence of the shocks, for, after the first day or two, the land-ice, by extending some 10 or 15 feet further than the front of the dam, formed a complete protection against the floating ice in the river.

The floating ice continued to increase up to the 15th of December, when it became so dense as to cut off all communication with the dolphin until the 18th, when it became stationary (in consequence of the resistance of the land-ice) to about 10 feet beyond the dolphin. The ice in the middle of the river continued to move until the 21st, although almost imperceptibly, on which day a regular communication between the towns was formed over the ice.

1841. The ice continued firm until the 17th of January, when, at about 3 o'clock P.M., it began to move in one unbroken sheet from the dolphin, where it had parted, to the Buda shore; a few minutes afterwards it began to move from side to side with tremendous violence. A stage, on which were three pile-engines for driving the piles on the upper part of the dam, was carried away instantaneously by the enormous force of the ice, which came crashing on till it touched the outer row of piles of the dam, when, after a squeeze which threatened to smash every timber, it broke up into small pieces, which kept rising up as forced on by the pressure behind, and formed an embankment against the side of the dam. The whole lasted about 10 minutes

and the first squeeze was the worst the dam had to contend with, but owing to the solidity of its construction, not the slightest damage—if we except that to the small stage above mentioned —was sustained.

A small space was always kept clear of ice, both round the dam and dolphin; as, in the event of the ice rising up perpendicularly, as sometimes happens, the piles might be forced out, and as much damage done in that manner as by lateral pressure.

The effect of the first pressure of ice on the dolphin was such as to create an apprehension that it would be entirely carried away; before the ice yielded to the resistance of the dolphin, it pressed it, as far as the eye could judge, about 18 inches out of the perpendicular, but as soon as the ice yielded it immediately recovered its upright position; and thus it continued, alternately being pressed and rebounding, for about 10 minutes, when a stoppage of the ice again took place.

As soon as practicable, the dolphin was examined, and the piles found, owing probably to the precaution mentioned above, not to have risen in the least; but that they had a lurch, or inclination towards the lower end and the Buda shore, of about one foot.

The pressure of the ice seemed to act in a direction quite contrary to expectation, inasmuch as the line of greatest pressure was supposed to act in, or nearly, the direction of the current; experience, however, proved that, in this case, the supposition was incorrect, the pressure being much greater in a diagonal direction, and towards Buda; and the reason appeared to be as follows.

On the Buda side of the dolphin are many warm springs, which, during a frost, are scarcely felt, but which, acting in conjunction with the warm weather which had preceded the moving of the ice, tended materially to weaken the ice on that side; and as the ice on the Pesth side, owing to the absence of springs, had stood quite firm, the effect of it in pushing the piles towards Buda will be perceived, the inclination towards that side being, indeed, much greater towards that side than down stream. When, however, owing to the floods from Upper Austria, the ice moves, the contrary is the case, as the stream, after passing Margarethen Island, sets in towards Pesth.

As the result of this experience seemed to prove that the base of the dolphin was not wide enough in proportion, piles were driven

all round at an angle of three feet in ten, and bolted and secured in the strongest manner to the dolphin.

On the 11th of March, the whole body of ice began to move, and after progressing for about five minutes, came to a stand above the dolphin and No. 1 dam, the remainder of the river being quite clear as far as the Blocksburg: shortly afterwards, the ice again made a movement, and formed a heap four or five feet higher than the top of the piles.

After the ice had got fairly in motion, and attained the velocity of the current, the noise and uproar of the immense masses, cracking and crashing against one another, and against the dolphin and dam, was tremendous, and altogether formed a scene it would be difficult to describe; sometimes a stoppage would take place, owing to the accumulation of ice between the dolphin and the dam, which kept that above back, until a mass of ice, more resembling an island than anything else it can be compared to, would force everything before it, breaking up the large blocks accumulated at the dam into a thousand pieces.

Considerable excitement prevailed at Buda, Pesth, and even at Vienna, owing to the different opinions as to whether the dolphin was sufficiently powerful to resist the pressure it was subjected to, and heavy bets were laid on the issue. The result, however, was most satisfactory; for, with the exception of the fender-piles, which were somewhat worn and damaged by the ice, not the slightest harm was done either to the dolphin or the dam.

A few days previous to the breaking up of the ice, it became evident that a considerable washing away of the gravel, by the action of the current, had taken place on the two upper sides of the dolphin. It was considered advisable, therefore, to sink a quantity of rubble stone, the same as that afterwards used inside the piers, where the washing away had afterwards taken place, and the event proved that this precaution was necessary.

On the 28th of March, 1841, the staging for driving the piles for No. 2 dam was commenced, and on the 1st of May the first pile was pitched. The average time of driving, including pitching, &c., was about $1\frac{1}{2}$ day to each pile; the timber was excellent, and drove well.

The gravel was taken out at the head of No. 1 dam, and the excavated space filled with good puddle to a depth of 12 feet, and

the piles for the middle row were driven through the puddle into the clay. They drove well, averaging about one day to each pile, and were driven 6 or 7 feet into the clay.

An engine-house, engine, and pumps were erected to clear the dam of water; the site of the engine, and position of the sluices to let the water into the dam, whenever it should be necessary, either from the pressure of the ice around, or from other causes, will be seen on reference to the front and end views of the dam. (Plates XII. and XIII.)

In spite of the precaution of sinking a quantity of rubble stone as mentioned above, the scouring action of the water round the dolphin still partially continued, and the gravel thus washed away was deposited by the action of the current at the lower end, where the water was in many places seven to ten feet shallower than before the dolphin was commenced; to remedy this, a quantity of rock stone was brought to the spot in barges and sunk; 1170 yards cube were thus deposited at a cost of 2*s.* 6*d.* per yard.

The quarries of Soskût, Waitzen, and Mauthausen were purchased by the Baron Sina, and worked under the direction of English foremen. The granite obtained from the latter was of most excellent quality, and of great size, and although there was at first much trouble in working the quarry satisfactorily, partly owing to the jealousy which the Germans entertained of the English quarrymen, and partly from the confined space in which work had to be carried on; yet as every stone got out enlarged the working space, this last objection soon disappeared.

The quarry at Waitzen (being 1200 feet above the Danube) was got into excellent working order before the autumn, and the stone found of very good quality and size; and considering the peculiar situation of, and bad roads leading to and from this quarry, the price at which it was delivered on the works, viz., 1s. per cubic foot, was considered very cheap.

The quarries at Soskût were also during this year much extended and improved, and so arranged that an almost unlimited quantity could be obtained.

Experiments were made by Mr. Tierney Clark at Pesth, in the autumn, on bricks furnished by various makers, viz., from Steinberger of Pesth, Cseeky of Ofen, and the Geminde of Alt-Ofen. Of these Steinberger's stood A 1 on the list of experiments

whose bricks were better made, and the clay more uniformly mixed than the other samples; his price was 16 florins (32*s.*) per thousand, which was considerably higher than was expected; the price eventually came down to 12 florins (24*s.*) per thousand, and again rose in consequence of the great demand to 15 florins (30*s.*), which was the price paid up to the last; the size of these bricks was $12 \times 6 \times 2\frac{1}{2}$.

EXPERIMENTS ON BRICKS.

NAME OF THE MAKER.	No. of Samples.	Weight of an English cubic foot in lb.		Increase of Weight in an English cubic foot.	Began to Fracture with a weight of	Crushing-weight.
		Dry.	Wet.		lb.	lb.
I. Steinbergen, Pesth . .	1	66·82	83·28	16·46	375·	1617
„ „ . . .	2	73·41	87·49	14·08	248·7	3188
II. Csecky, Buda . . .	1	89·46	104· 7	15·24	1600·	1926
„ „	2	76·23	90·77	14·54	468·	1320
III. Christ, Buda . . .	1	78·03	90·81	12·78	937·	1237
„ „	2	77·9	90·96	15·06	1087·	1712
IV. Lechner, Pesth . .	1	71·77	92·06	20·29	400·	775
„ „ . . .	2	91·88	117·88	26·	1375·	2012
V. Gunsberg, Raab . .	1	70·94	88·89	17·95	375·	500
„ „ . . .	2	70·8	89·16	18·36	737·	1047
VI. The Town of Old Buda .	1	81·37	92·87	11·5	1400·	2266

All the quantities in English Measure.

It was found by no means easy to obtain a suitable lime for hydraulic purposes, almost all the samples slaking with great difficulty; the Styrian lime, in particular, would scarcely slake at all. The common lime of the country slakes nearly the same as the English, and is of good quality, as is proved by the buildings at Pesth, many of which are coated with it, and resist the effects of the atmosphere for many years.

After considerable trouble and anxiety, an excellent lime-stone was eventually obtained from near Peterwarden, on the Servian frontier. It being feared that if the stone was burned, and ground on the spot, it would often be damaged and spoiled, in consequence of the distance it had to be conveyed, viz., by water, all against the stream, 200 miles to Pesth, Mr. Tierney Clark

determined to have it burned on the works, in a flare-kiln, and then reduced by an edge-stone mortar-mill. The district from which the most excellent lime-stone was procured belonged to a monastery; the abbot of which, hearing it was to be used in building a national work, and one of so great advantage and utility to his country, called on Mr. T. Clark and expressed himself greatly pleased in being able to forward such an object, and would accept of no payment for the stone; the carriage therefore to Pesth was the only expense until delivered on the ground. Several experiments were made with this lime to test its fitness for hydraulic purposes, and a mass of brick and rubble-work was prepared and laid under water; after a short time it was taken up, when it was found that the mortar had set so firmly that it was the hardest part of the mass.

The piles at the lower end of No. 2 dam drove considerably harder than those at the upper; but still the difference between the driving of No. 1 and No. 2 was very great; to give some idea of this, it may be mentioned that the number of piles damaged and re-drawn in the former was, on the average, about thirty-eight per cent., while in the latter it was about seven per cent.

A twenty-five horse engine and pumps arrived in the autumn for the purpose of clearing No. 2 dam of water, and was fixed on the dolphin. (Plate XII.)

1842. The last piles for both dams were pitched just before Christmas, and by the 3rd of January the puddle was got into No. 1 dam as high all round as the middle walings (Plates V. and VI.), when the frost put a stop to the operation. On the 10th of January the pumps were got to work, although with considerable difficulty, owing to the frost, and in eight hours the water in the dam was pumped out down to five feet below zero. As soon as practicable, a well was sunk down into the clay in order the better to keep the dam free of water. During the excavation, the reason why the piles drove so hard, when just about to enter the clay, became apparent. Immediately above the clay, and in such intimate connexion that it seemed almost to form a part of it, was found a thick crust of stone, from 6 to 12 inches, the surface of which was very irregular, but smooth, as if worn so by the attrition of the large gravel and stones in immediate contact with it.

The pumps continued to work well in spite of the severe frost,

the little water which found its way into the dam had from 6 to 7 degrees of warmth (Reaum.); this, when there was 16 degrees of cold in the air, seemed not a little extraordinary, and is to be attributed to the fact that the leakage was mostly at the back of the dam, and in the same stratum as the wells at Pesth; the water from which was always about 2 degrees warmer than that in the dam, whilst the water in the Danube, 10 feet below the surface, was just about freezing point.

By March, the whole of the ground inside the dam had been excavated, and it was found that the superstratum of sand was of so soft and yielding a nature as to require to be entirely removed down to the stone-crust overlying the clay, and the excavated space filled in with concrete. During the excavation, it became apparent that the whole of the piles forming the inside row were more or less shattered at the bottom; in consequence of which a fourth tier of walings was fixed all round the inside of the dam.

The first pile for No. 3 dam, on the Buda side, was pitched on the 8th of April. The piles at first went tolerably easy; but as the driving proceeded they took six or seven days to get down; and in consequence of the great time requisite to drive them home, 5 feet was settled on as the depth to which they should be driven into the clay in future.

From the first it was feared that this No. 3 dam would prove a source of great difficulty and annoyance, and the result fully justified the expectation. As the driving proceeded, the piles went with even greater difficulty than at first; often the operation took from twelve to fourteen days to each pile, which in many cases broke off short in the ground, and could not be withdrawn. To remedy this, the gravel was dredged out to the lowest practicable depth; and where the piles had broken off, or were otherwise considerably damaged, a second row was driven immediately behind the first.

The first pile for No. 4 dam was pitched on the 12th of May, 1842. The piles for the most part drove very well: the excavation was at the same time proceeded with. About 30,000 yards cube were necessary to be excavated from this dam.

Travelling cranes and framework were erected over Nos. 1 and 2 dams. On the 24th of August, 1842, the first stone was laid by

the Archduke Palatine, representing His Imperial Majesty of Austria.

On this occasion the Archduke Palatine invited the principal magnates of Hungary to dine with him previous to laying the foundation-stone; and Mr. T. Clark had the honour of being one of his guests. After the ceremony of the dinner, Field Marshal the Archduke Charles presented to Mr. Clark, in the name of his Imperial Majesty Ferdinand the First, Emperor of Austria and King of Hungary, a magnificent gold box, set with brilliants. In the centre of the lid was the initial F., in brilliants, surmounted by a wreath of the same, with large brilliants at each corner. The cortège then left the imperial palace, with an escort of the military, for the Cofferdam No. 1, a most imposing sight, from the variety of the rich costume of the magnates.

TRANSLATION OF THE DOCUMENT, IN THE HUNGARIAN LANGUAGE, PUT INTO THE FOUNDATION STONE OF PESTH SUSPENSION BRIDGE, ON THE 24TH OF AUGUST, 1842.

The idea of connecting the shores of the Danube between the towns Buda and Pesth by a permanent bridge was brought forward by Count Stephen Széchenyi: at first, in a private circle of some inhabitants of those towns and of the kingdom, afterwards before a society under the title of the "Buda-Pesth Bridge Society:" and he began to collect the data serving for this purpose. With the same intention he, together with Count George Andrasy, visited England in the year 1832, and they published, on their return, the information gained there, together with their own opinions, under the title of "Report of Count George Andrasy and Count Stephen Széchenyi, made to the Buda-Pesth Bridge Society on their return from abroad. Presburg, 1833." The subject, thus ripened and prepared, was at last brought before the Diet assembled at that time; where, it having been supported by his Imperial Royal Highness the Hereditary Archduke of Austria, Joseph Anthony John, the beloved respected Palatine and Governor of Hungary, and by the assembled States of the Realm, the xxvi. law-article (act) of the year 1836, was, with the sanction of his gloriously-reigning Apostolic Majesty King of Hungary, Ferdinand the Fifth, passed, by which act the erection of a permanent bridge between Buda and Pesth, through the medium of a share-holders' company, was granted; and for the realisation of the object, an imperial committee was appointed. Acting on this law—one of a new kind aiming at the benefit and ornament of the country—the Baron Simon George Sina made the proposition to build a suspension chain-bridge between Buda and

Pesth, at the expense of a shareholders' company, to be formed by him, and according to the design and under the direction of the English artist Mr. William Tierney Clark, and he closed a contract on this subject with the Diet Committee on the 27th of September, 1838, which contract was afterwards declared valid by the xxxix. article of 1840. The works, in consequence thereof, were begun about the end of October, 1839, have since that time proceeded without interruption, and

THE FOUNDATION-STONE

of this suspension bridge has, with the usual ceremonies, and in the presence of a numerous assemblage, been most kindly laid this day, the 24th of August, 1842, under the paternal reign of his glorious Majesty Ferdinand the First, Emperor of Austria, as King of Hungary the Fifth of his name, by his Imperial Highness Charles Lewis John Joseph Lawrence, hereditary Archduke of Austria, Knight of the Golden Fleece, Grand Cross of the Military Order of Maria Theresa, and first-class knight of several other illustrious orders, Governor and Captain-General of Bohemia, Imperial Field-Marshal-General, Proprietor of one Infantry and one Lancer Regiment, as representative of the highest person of his Imperial Reigning Majesty, most graciously appointed for this purpose. In remembrance whereof, this document and different coins of his Imperial Reigning Majesty Ferdinand the First, Emperor of Austria, as King of Hungary fifth of his name, have been put into the foundation stone.

The document had been signed by his Majesty the Emperor of Austria and King of Hungary, Ferdinand; and it was signed on the spot by the Archduke Charles, Archduke Joseph, Palatine of Hungary, the Archduchess Maria Dorothea, Prince Joseph, and Princess Elizabeth, the present high dignitaries of Hungary, Count Stephen Széchenyi, Baron George Sina, Baron John Sina, some chief magistrates of the county of Pesth, the principal engineer, William Tierney Clark, the General Secretary of the Buda-Pesth Suspension Bridge Company, Anthony Tasner, and some other present persons.

In pursuance of the plan agreed on, the dredging for No. 3 dam was carried on to the average depth of 44 feet from the top of the outer row of piles, leaving about 10 feet of gravel to drive through, and extra piles were driven where the gravel found its way between the piles, as well as where it was known the piles were not driven to the proper depth, or were broken or otherwise injured. As the gravel was dredged out to the above depth, the

inner and middle rows were driven, and a great part of them got down as was supposed to the requisite depth.

The work was carried on in the above manner until the 7th of November, when from the appearance of several piles which were pulled up, and from other causes, it became apparent that the outer row (Plate xv.) was in a much worse state than had been expected, and was almost a matter of certainty, that those piles which had taken 10 or 12 days to get down, were not driven to the proper depth by at least three or four feet, having upset or lost their points to that extent. There was likewise every reason to believe that many of them were broken or dangerously crippled; added to this, the Danube was rising, and at the late time of the year with winter rapidly approaching, the general appearance of the dam was anything but satisfactory.

Upon mature consideration, the only course appeared to be to drive a much greater number of piles than was at first calculated upon, and another complete row of piles was driven all round at intervals of 15 inches apart, and in some cases double and triple piles were driven during the progress of the dredging. At the commencement of the driving, a few were got down to the depth of 57 or 58 feet, being from three to four feet in the clay; but as the gravel began to get compressed, many of them would not penetrate more than 54 or 55 feet, the sharp angular gravel, overlying the clay, appearing to be compressed into a substance as hard as rock.

The piles in No. 4 coffer-dam drove far better, and the making of this dam was, in comparison, easy to No. 3; a wharf was made, and two cranes erected before the winter. During the process of puddling, however, between the first and inner rows of piles, a large piece of rock was found imbedded in the space between them, which it very nearly filled up, and precluded the driving of the middle row at that part. Nothing therefore remained but to fill in between the two rows with puddle. Before the magnitude of the rock was ascertained, every expedient was resorted to to get it up, but without the slightest success.

After the fourth course of stone was laid in No. 1 dam, bringing it up to zero, the ice put a stop to further progress, and the water was let in by the sluices shown in the views of the dam, in order to equalise the pressure within and without. In No. 2 dam, on the contrary, the ice not being nearly so massive, the pressure

against the dam was not so great, and the masonry was continued.

During the winter the excavation for No. 4 dam was carried on, and the framing for the travellers erected. This dam was almost water-tight, the only spot where any leak was apparent being close to the large mass of rock above mentioned; however, by fixing a fourth tier of walings as low as possible, and by the greatest care being taken to render that part as secure as possible by means of extra braces, &c., this leak was made of very little importance.

1843. The water rose very considerably during the winter and earlier part of the spring, and by washing away the bank where it came in contact with the piles, soon formed a passage large enough to fill the dam; this was remedied in a temporary manner by continuing the outer row of piles some distance into the bank, filling-in and backing-up the space outside with puddle; and to guard against anything of the kind for the future, when a leak might be of more consequence, half timber bay-piles were driven to fill up the space between the gauge-piles at the back of the dam, and then backed up with clay, so as completely to close the dam. A small high-pressure engine and pumps were erected to clear this dam of water, and worked well.

The water rose very considerably in the months of June and July, and attained the height of 14 feet 5 in. above zero, with a tremendous current. The pumps kept the water down in No. 2 dam, with the exception of one day; but in Nos. 1 and 4, the leakage greatly exceeded the power of the pumps, and the works were at a stand-still for some days. The current is always very rapid in the Danube, generally from 6 to 7 miles per hour.

This rise in the water threw No. 3 dam very much back, a great quantity of mud and silt being deposited in it, between the outer and middle rows of piles, owing to the Danube flowing over those two rows; this stopped the dredging to a considerable extent, and caused a great loss of time in finishing this troublesome dam.

The lower granite quarry at Mauthausen was also completely under water, and stopped work for some time; the loading-wharf was also under water, and prevented some stone which was greatly required being sent. This rise of the water, to be attributed to the melting of the snow on the mountains of Upper Austria, caused many serious accidents from some of the large country boats

breaking loose, and, besides doing other damage, carrying away part of the bridge of boats. Several market-boats were also upset, in one of which from seventeen to twenty persons perished.

In the course of the summer, three floods took place, causing considerable hindrance; and each time, depositing a quantity of silt and mud in Nos. 3 and 4 dams.

Mr. Tierney Clark proceeded to Pesth in the autumn of this year, and endeavoured, without success, to get an examination made of the state of the piles in the No. 3 dam; owing to the great depth of water, 50 feet, and the situation of the piles, the ordinary diving-bell could not be used. Some of the most experienced divers were sent for from the swimming-school, but, after several trials, they gave up the attempt, finding that they could not descend more than 25 feet; the pressure then being just supportable; accordingly, a diving-dress was ordered from England, and proved of the greatest utility throughout the work.

The first stone for No. 4 pier was laid by Mr. Tierney Clark on the 22nd of September.

During his stay at Pesth, Mr. Clark made a trial of two cast-iron beams for the roadway. They were made at Pesth, at the Walz-Muhle, a small foundry established by Count Széchenyi, and were submitted to the test of five tons, suspended in the centre; when the deflection, arising from the defective preparation of the iron, was so great as to destroy its elasticity; rendering the beams cast of such metal useless for the purposes intended. The pattern was then altered by increasing the depth to make up for the want of strength in the iron, and further improved by the addition of an admixture of old scrap iron. This third beam was then tested with the same weight as the others, and the deflection found to be not more than one half of the latter. This result, however, was attained by the addition of 5 cwt. to the weight of the beam: this was considered strong enough for all purposes. A great advantage resulted from this trial, inasmuch as it proved that the beams could be made in Hungary; whereas it was before feared they would have to be cast in England—a serious addition to time and expense.

On Mr. Clark's return to England, his first attention was given to provide for the manufacture of the chains. This very important part of the undertaking was performed by Messrs. Howard & Ravenhill of Rotherhithe.

No. 1 pier had by this time—namely, the date of Mr. Clark's leaving, in the beginning of October—been raised about 20 feet in height, and might have been raised considerably higher had there been a better supply of granite, which was in part prevented by the unfortunate circumstance of several vessels, having on board granite for the back of the fixture-pier, getting aground, and much time was in this manner lost.

No. 2 pier was raised still more, namely, about 21 feet high; the workmanship, equally with that of No. 1, being most excellent.

No. 3 coffer-dam, which under ordinary circumstances might have been finished by the autumn of this year, still gave a great deal of annoyance and trouble. All the gauge-piles were found to be in good condition, and many of them 6 to 7 feet in the clay; but the inner row was found sadly defective, and, although the dredging was carried on to the lowest practicable depth, still continued to drive with great difficulty, as above the clay there was, in addition to the gravel, a hard slaty incrustation, through which the piles had to be driven; and this, added to the great depth of water, formed an obstacle which was only overcome by the most unceasing exertions and by untiring energy and perseverance. In addition to the above-mentioned sources of difficulty, when the water rose the dredging had to be discontinued; and when it subsided, left a quantity of silt and gravel in the dam, and no sooner had this been cleared away than another flood rose producing the same results, and this happened three times. Another evil arising from the high water was, the washing away of the gravel round the outer row of piles; this, however, was remedied by throwing in a great quantity of rubble-stone and also bags of clay all round the dam, in order to keep the piles upright against the great weight of the mass of puddle between the rows. (See Plates IX. and X.)

The winter of 1843-1844 was fortunately mild; nevertheless it was considered expedient to load the piles of No. 3 dam with blocks of stone, to prevent any tendency to flotation consequent on the washing away of the gravel, as detailed above. In the following spring, the pumping-out of No. 3 dam was commenced. This succeeded better than was expected, though several leaks occurred, and also a blow of fine sand, which caused the puddle

between the piles to sink down considerably. The engine and pumps used for this dam were taken from No. 1.

1844. Mr. Clark arrived at Pesth in September, and in his report to the Baron G. S. Sina mentions the following progress as having taken place in the works since October, 1843.

No. 1 pier had been raised 18 feet since the last autumn; and confident expectations were entertained that, if the weather proved favourable, the pier might be raised up to the level of the roadway in the course of the season.

No. 2 pier had been raised about 21 feet since the last report. The materials and workmanship of both piers first-rate.

The whole of the season had been very unfavourable, from the constant high state of the water, for finishing No. 3 coffer-dam. Mr. Clark, on examination of the piles, found them generally in a very crippled state, and additional piles had to be driven, and extra bracings fixed for their support. This bracing being carried round most part of the dam, added considerably to its stability. The completion of the dam, however, had been delayed for some time owing to the sediment under the puddle running out between the defective piles into the dam. This occurred several times, each time bringing with it the sand that remained under the puddle, and which could not be entirely dredged out, as well as some of the puddle itself; and as this had to be cleared away each time before fresh operations could be commenced, this of course was a source of considerable delay; but when free from these accidents, the dam was so nearly water-tight, that a small hand-pump was sufficient to keep it dry.

The accident which occurred to No. 4 dam, as before mentioned, during the last autumn, had been repaired at a comparatively small expense, and made perfectly secure, and the masonry within raised 15 feet.

The Count Andrasy sent, while Mr. Clark was at Pesth, two roadway beams, cast from his own foundry, according to a pattern furnished him. These beams were subjected to the required test, and stood it extremely well; and at the request of the Count one was broken by a weight of fifteen tons suspended from its centre, the distance apart of the bearings being 26 feet 9½ inches. Some air-holes existed at the point of fracture, or probably it would have stood a much greater weight, as the iron was most excellent.

Mr. Clark also made several experiments upon iron-bars, furnished him by various parties in Austria. The bars were sand castings, one inch square, English measure, and three feet distance between the bearings. Those from a foundry belonging to Baron Rothschild, Count Andrasy's, and a specimen from the flour-mill established, like many other things of great utility, by Count Széchenyi, were found to be the best, the mean of the three experiments being 917·99 lb. per square inch.

EXPERIMENTS ON THE STRENGTH OF CAST-IRON BARS.

		lb.
7	bars from the Flour-Mill, on the average, broke with	867·81
2	Concordial	744·57
4	From the Foundry of Baron Rothschild (planed) .	1181·342
8	From ditto ditto (sand-castings)	981·18
3	From Hoffman Brothers	702·53
2	From Count Andrasy	904·08
26	Experiments.	

The piles for No. 3 dam continued to be driven where the dam was defective, on the Buda side, and the puddle to be rammed down by driving a piece of timber 30 to 40 feet into it; this plan was found exceedingly good. On the 4th of October the dam was pumped out, and the 7th and 8th tiers of walings finished; but, on the 12th, a leak broke out in the old place, on the Buda side, but after running for a few minutes, the puddle settled down, and stopped it again. On the next day it again broke out with great violence, and although the sluices were immediately opened, a great quantity of puddle came in before the dam could be filled, the Danube being rather low at the time, and the sluices half out of water. After driving a pile in the defective place, and making good the puddle, the water was again pumped out, and the dam remained tolerably tight till the 17th, when a serious leak again broke out in the same place; the water, however, this time, came in quite clear, without bringing any admixture of sand or puddle along with it, there being no appearance of its stopping. The sluices were again opened, and the dam filled, after which the clay was driven down as before, and two piles driven behind the outer

row, there being no appearance of any defect in the inner row where the water came in.

One of the long sheeting piles was also driven at the upper end of the dam; it went tolerably well till within about two feet of the clay, when it could be driven only a quarter of an inch at a blow, with a 20-feet fall, and when within a few inches of the clay, ceased going at all, and split at the top.

On the 18th the engines were again started, and on getting out the water sufficiently low, one of the *short* sheeting piles was driven at the side of the dam with a large wooden monkey, weighing a ton and a half, and found to go perceptibly better than the long one. When the point was one foot in the clay, it went three-eighths of an inch, with a 15-feet fall; this pile was got 3 feet 10 inches into the clay, and would have gone further, had not the upper part been crippled. This experiment showed the great advantage of this mode of driving short sheeting piles, instead of driving long ones, in the usual manner.

Owing to the sluices being half out of water when the dam (Plate xv.) was filled on the 13th, they were rendered comparatively useless, and had the leak been of more serious character, the consequences might have proved very disastrous; and as there was a probability of the Danube falling still lower, or even of having the sluices above water, some remedy was necessary; the following plan was therefore adopted:—

A few piles were driven at the lower end of the dam, and the space they enclosed filled in with puddle to the depth of about 9 feet, so as to form a water-tight bottom above the rubble, and an open box with a loose bottom sunk some distance into it, and on this the sluice was fixed. This box was screwed down upon the puddle by jacks, to prevent the pressure of the water outside from blowing it up.

Two borings were made on the side of this dam at those points where the piles drove with such difficulty, and it was found in both instances, that the common gravel continued to within about two feet of the clay, where a layer of gravel was found, so hard that it was with the utmost difficulty that the auger could penetrate through it. This stratum seemed to be a kind of conglomerate or natural concrete.

As above mentioned, to prevent flotation, the dam was

loaded in the autumn with stone, leaving interstices between the stones by which the puddle might be renewed in case of need; the quantity of stone thus deposited on the dam was about 800 tons.

1845. In the following January the water having been, with some trouble, pumped out of the dam, an examination of the piles was made, and some few, which appeared broken or otherwise damaged, were re-drawn, and after getting up two from the lower, and three from the upper end of the dam, it was found that they had *all* lost their shoes, and to have their points staved up about 18 inches.

As the majority of the piles drawn since beginning to drive the sheet piling were found to be sound with the exception of their points, it was supposed that the seats of the shoes might be too small; some large, old, heavy shoes, with the seats 6 in. by 12 in., and weighing 110 lb. each, were altered so as to give them a blunter but stronger form, the sides of the shoe being rather convex; these were then tried, but after being driven within one or two feet of the clay, they were found to upset and give way as much as the others.

One of the piles on the Buda side of the dam was also drawn and found to have lost 9 *feet*, the stump having split all to pieces; yet this pile went regularly one inch every three blows for the last 6 or 7 feet.

Serious apprehensions were now entertained as to whether *any* of the piles had gone down to the requisite depth, and to set this at rest, the pile No. 4 on the Pesth side of the dam being, in the opinion of all on the spot the best, was drawn; however, it appeared that this was very little better than the rest, being found to be no less than 4 feet 9 inches short, the points of the stump having penetrated about 15 inches into the clay, as a small portion was found between the crevices.

Two of the best pieces of timber in the yard were now prepared, as a last trial of the possibility of driving the sheet-piling through the existing gravel into the clay. These piles were shod with a strong cast-iron shoe or socket, with a driving-seat nearly equal to the entire cross section of the timber. One of these was driven until apparently 8 inches in the clay; on being drawn, its shoe was found gone, but the point upset about 2 inches only, being

in other respects quite perfect; the other pile, shod at the *butt-end*, was drawn when apparently 16 inches in the clay, when it began to split badly at the top, and found to be quite perfect at the point although the shoe was gone; showing the great difference in the gravel as to density and compactness.

As soon after the above particulars as the ice would permit, a well was sunk in the middle of the dam; at first, fine angular gravel continued without intermission until within about two feet of the clay, when a stratum of a coarser kind made its appearance, but even this was not particularly hard; but just before coming to the clay a quantity of flat, round stones, of about 15 or 18 inches diameter made their appearance, forming a pretty evident reason why the points of the piles were so damaged. The clay itself was found extremely hard and compact, and gave promise of a most excellent foundation, in case the difficulty of driving the piles was surmounted.

The severe frost (9° to 10° Reaum.) which now succeeded, put a stop for a time to further operations; the whole dam being one mass of ice, produced a most strange and picturesque appearance, every pile and beam being also encrusted thickly with ice, and covered with icicles of the most fantastic shapes, which formed as the water left them.

As soon as the weather permitted, a plan which had been under consideration for some time was adopted, viz., of driving half piles (8″ × 15″ or 17″) by a ringing engine or monkey, of five cwt., the jar caused by which was so little, that the dam could be kept clear of water during the operation, which was found quite impossible during the driving of the large piles; this plan possessed the additional advantage of allowing the middle space to be excavated during the driving, and then filled in with rubble the requisite height; by this means, also, the gravel could be moved in short lengths, and otherwise loosened so as to facilitate the descent of the piles.

The first piece of rubble-work was laid on the 3rd of March, by the Count Széchenyi, on the solid clay, and 220 men were kept constantly at work at this dam alone.

The plan adopted in driving the sheet piling to the dam was as follows:—The ground was removed about four feet deep, before a bay of piles was pitched; they were then driven as far as they

would go, about three or four feet, when the waling was fixed and strutted, and as much more of the gravel taken out, as left the points of the piles 18 inches or 2 feet in. (Plate xv.) A man was then employed with a kind of crowbar, with a spear-shaped head, about four inches broad, to stir up and loosen the gravel opposite the pile which was being driven; and in this manner the whole bay was got down to within a foot or 18 inches of the clay, when more of the gravel was taken out to allow of the lowest waling being fixed and properly braced, by the raking diagonal struts, up to the tier above them. After this waling had been secured, the gravel was further loosened, and the pile driven until it had penetrated from 9 inches to 2 feet 6 inches, and in some cases 3 feet in the clay. About two bays in length and one-and-a-half in breadth, were then cleared for building, and the rubble, composed of excellent soft gritstone, was then laid on the solid clay, and well grouted in.

In Mr. Clark's Report, dated from Pesth, whither he arrived in the beginning of August, to the Baron S. G. Sina, he gave the following account of progress made since last year:—

No. 1 pier was raised within two courses of stone of the carriage-way, or finished height, and a large portion of stonework was on the ground ready dressed for its completion.—Plate xxiii., &c.

No. 2 pier was raised considerably above the coffer-dam, and within one course of the level of the carriage-way.—Plates xvi. and xvii., &c.

No. 3 dam was, by the continued perseverance of Messrs. Adam Clarke and Teasdale, the senior and second clerks of the works, finished. The third course of stone was set, and the first five courses were expected to be finished before the winter closed in. All the men were kept at work till ten o'clock at night, and one gang all night, to unload the stone ready for the next day—a course productive of much saving in time, and but little additional expense.

No. 4 pier was also in a very satisfactory state, and confident hopes were entertained that by the next year the same progress would be made as by No. 1 in the present.

The winter of 1845-6 was more remarkable at Pesth for the unusually foggy and rainy weather which prevailed than for severe frost; and, in consequence, little progress was made during the

depth of the season, it not being possible to work more than eight hours per day. The first piece of granite parapet was finished in January; the cost of this first piece was 5*l.* 18*s.* 9*d.*, and, being fifteen feet long, nearly 8*s.* per running foot. The expense, however, was much heightened by the bad weather, and by being worked by day-work: subsequently the cost of granite, including *all* expenses, was three florins = 6*s.* per cubic foot.

The water stood uncommonly high during the winter and early part of the spring; on the average, 14 ft. 2 in. above zero, but with very little ice. During the continuance of the high water, the dams were kept constantly full by means of the sluices.

As before stated, the chains were made by Messrs. Howard & Ravenhill, of Rotherhithe, and cost 21*l.* per ton, exclusive of freight, &c. Gauges were made by Messrs. Troughton & Simms, in order to insure the greatest accuracy; the dimensions of the links, and their form, will be seen on reference to Plate xx. c, the retaining link and bar at Plate xxv. Machinery such as had never been in use before had to be made, for the manipulation of the chains, all of which was patented, as well as the manner of forming the links in the rough, which was quite new, and, in addition to being the best and most perfect mode, was by far the most economical.

The first delivery took place before the 2nd of October, 1846, according to the contract, and weekly shipments of about 15 tons took place, until the completion of the contract. The manufacture of the chains took place in the following order, viz. :—

1. The four bottom tunnel chains (Plate xxiii.)
2. The four curved links for retaining piers (Plate xxiii.)
3. The four curved links for towers (Plate xxi.)
4. The two top chains complete (Plate xi.)
5. The two bottom chains (Plate xi.)

The bed-plates and roller carriages (Plate xxi.) were made by Messrs. Hunter & English, of Bow, at a cost of 3000*l.* The blocks for hoisting the chains were manufactured by Messrs. Harvey, of the Hayle Foundry, Cornwall, and cost 750*l.* These blocks were the largest ever made, and the details of their construction will be seen on reference to Plate xxii.

Mr. Tierney Clark arrived at Pesth in July, and, in his annual

Report, gives the following account of the progress made since last year :—

No. 1 pier was completed so far as to be ready for the stone work for fixing the bed-plates at the head of the pier (Plate XXIII.), and the stones for that purpose were being quarried.

No. 4 pier was very nearly as forward as No. 1, and would be ready at the end of the season to receive the bed-plates and roller carriages, as well as the retaining plates, so that the chains might be fixed in the pier, as shown in Plate XXI., in readiness for their connection with the main chains.

No. 2 pier was finished to the height of the roadway, and both the granite plinths for forming the opening of the archway were set, as well as one course of stone above, and the last lift of the scaffolding (see Plates XII. and XIII.) was fixed at its proper height.

No. 3 pier had been raised 49 feet since the laying of the foundation on the 6th of July last year; there was, however, a great deal of masonry to be done on this pier before it would be ready for the reception of the roller carriages, and Mr. Clark gave instructions for the employment of more hard stone masons on this pier, and more granite masons were sent for from Italy.

The next point of serious consideration was the safest and most expeditious manner of hoisting the chains, and it is necessary to state that they were the heaviest ever attempted to be raised; the total weight of the centre chains alone, including tension-rods and blocks, exceeded 7940 cwts. = 440 tons. This weight will give some idea of the enormous strength necessary to be possessed by the machinery, as well as the necessity of having all parts of the very best materials and workmanship. The shafts and wheels to make the necessary connection with the 25-horse engine, for winding up the chain fall from the blocks, were made in Austria, but the chain fall itself, and blocks, were obliged to be made in England, and, as before stated, were manufactured by Messrs. Harvey.

The roadway beams and cantilevers were put in hand in the latter part of the autumn of this year, at the "Walz Muhle," and cost 12 florins per Vienna cwt.

The foundation for the wing-walls to the fixture piers was completed before the winter set in. Considerable difficulty was

experienced close to the dam piles outside, owing to the mud, &c., extending nearly down to the clay, it having filled in after the dredging for driving the piles there. (See Plate XXXII.) The season was very favourable for the completion of this wall. The depth of it averaged about 20 feet from the surface of the ground, except in that part where the mud, &c., had been deposited by the dredging, and the depth in this place, viz., close to the piles, was about 32 or 33 feet.

1847. The winter was a mild and very favourable one, and during its continuance the foundations for the wing walls on the Buda side were got in, and made rapid progress. As the inhabitants of Pesth, Buda, and indeed the whole country, were most anxious and impatient to push the progress of the work to the speediest completion possible, arrangements were made to meet this end. Before this period, night-work had, as far as possible, been avoided, and, in consequence, as the working space on Nos. 2 and 3 piers was so contracted, a limited number only of men could be employed on them, and the time of the setting machines was pretty nearly divided between *lifting* the stone, and *setting it* when raised; and, in order to enable the setters to be constantly occupied with their proper work, instead of being half their time in raising, the following plan was adopted with great success. The entire day was devoted to setting, and the night to lifting the stone, of course by separate gangs; and to prevent the blocking up of the working space by the quantity of stone, stages were erected over the pier at different heights, on which the stone was deposited during the night, and by these means the surface of the course in work was always kept free from incumbrance.

During this time a boring machine was being made at Pesth, for the purpose of boring out the recesses into which the retaining bars fitted (see Plate XXIV.), after the plates had been permanently fixed in their places, so as to insure the greatest possible accuracy.

The following work had been done, by the date of Mr. Clark's Report in September, 1847:—

No 1 retaining pier was finished, with the exception of the toll-houses and parapet walls. The stone for the toll-houses and pedestals was in part on the works, and the greater part of the granite for the parapet walls was already worked ready for setting.

This pier might have been quite finished by this time, but, as the other piers required all the attention and dcspatch possible, this part of the work was not pushed. The retaining plates were fixed and ready to receive the chains.

No. 2 pier was finished ready for receiving the chains, the masonry being raised to the level of the roller carriages, which were in the yard, and preparations being made for fixing them.

No. 3 was in so forward a state, by means of the great exertion that had been made, that in about a month it would be ready to reccive the roller carriages, which were in readiness.

No. 4 pier was in the same state of forwardness as No. 1, the roller carriages were fixed, as well as the retaining plates, and the wing walls were in progress.

A great quantity of larch timber for the platform had arrived from the Styrian monntains, and was being prepared and dressed up for that purpose.

About 530 tons of links and bolts had been delivered, and another cargo expected shortly; about 79 cast-iron beams were in the yard, and in progress of being tested and examined.

Preparations were being made for raising the chains between Nos. 1 and 2 piers. The steam engine was fixed, and all other arrangements made for commencing operations as soon as the curved links, blocks, and falls arrived from England.

In order to arrive at the real average weight of the larch timber for the platform, 31 pieces of different scantlings and lengths were picked out, from 40 to 60 feet; these pieces were then carefully cubed and weighed, and the exact average weight per foot cube, was found to be 38·65 lb. The average weight of the white fir for the foot-path and nosing was 25·7 lb. per foot cube. The total quantity of timber in the middle openings was 19,857 cubic feet of larch, and 3,455 cubic fect of whitc fir.

1848. It had been originally proposed to raise the chains in the autumn of this year, that is to say, the backstay chains, or those betwcen Nos. 1 and 2 piers (Plate VIII.), and this would undoubtedly have been done, had it not been for the great delay occasioned by the non-arrival of the iron work; and, owing to defective supervision, 200 tons had been suffered to accumulate at Frankfort, which should have been sent on to Pesth long before. The freezing of the Danube also delayed the carriage for some

weeks, and ultimately a portion had to proceed by land-carriage—a most expensive and uncertain mode of conveyance.

The towers were in readiness as well as the fixture piers, all having the roller frames and plates fixed ready for the reception of the chains, by the beginning of November; but, in consequence of the non-arrival of the iron-work, it was found impracticable to commence before the spring. The early part of the winter was, fortunately, tolerably mild; had it been severe, the result, as to the delay of the chains, &c., might have proved of serious inconvenience. In February, however, a great quantity of snow fell, and severe frost succeeded; and the ice, after continuing for a few weeks, broke up with great violence, about the middle of the month, and tore away a great portion of the round fender pieces of the dolphins above Nos. 2 and 3 piers, but did little or no damage to the framing itself. The gearing of the sluices of Nos. 1, 2, and 3, was likewise torn away, as, indeed, everything else which afforded the slightest projection for the ice to lay hold of. A great deal of damage was also done to the shipping and boats of the country, many of which were driven down the river, imbedded in the ice. The water rose greatly above, and did considerable damage to property: altogether, this was the severest break-up since the year 1838.

The first upper backstay chain was got up on the 28th of March, without the slightest difficulty; the blocks, crab, and gearing working extremely well. The position of the blocks, and process of hoisting the chains, will appear on reference to Plate VIII.

It was about this time that the first serious apprehensions were entertained concerning the state of political affairs in Hungary. A very strong party had been formed, who had for their object nothing less than a revolution in the government of Hungary, to make their country a separate and independent state, but *nominally* under the Emperor of Austria; and this party appeared to gain ground daily, and fears, which were afterwards realised, were entertained that this party would not separate until they had struck a blow somewhere. Just at this time, the most important part of the iron-work, viz., the chains, were on their road to Pesth, and had any occurrence taken place to stop them, the works would have come to an absolute stand-still. Luckily, the chains had all arrived before any violent outbreak occurred.

The Emperor and Court left Vienna in April. In Hungary, the Croatians were in open rebellion, and artillery, &c., were daily leaving Pesth, in steamers, for different posts up and down the Danube; and in the early part of May, the military came in contact with the populace of Buda, and several were killed. In order to assist their country in this critical situation, all the nobility and gentry delivered up their plate and other valuables to the government. The Count Széchenyi was one of the first to set the example of presenting nearly the whole of his magnificent service of plate, and others soon followed in proportion to their means.

In the beginning of June, there was an almost universal strike amongst the workmen in Pesth, and on the 8th a mob of about 1000 visited all the large establishments in and around Pesth, for the purpose of compelling the managers to employ none but Hungarian workmen, and to send away all foreigners. The Railway and Walz Muhle, probably intimidated by force, yielded, and made the required concessions, and signed a paper to that effect. The mob then came to the work-yard at the bridge, and reiterated their demands. Mr. Adam Clarke declined making any arrangement whatever with them, except what the constituted authorities ordered; and, whilst they were haranguing about "Freedom" and "Equality," sent off messengers to the magistracy and Chef de Police of the Minister of the Interior, and just as they were getting ready for mischief, Count Széchenyi made his appearance, and engaged their attention by giving them a speech in Hungarian until the guard, consisting of about sixty men belonging to the yard, armed with muskets and bayonets, got under arms, and showed a formidable front, which held the mob in check until the arrival of the Chef de Police, who ordered them to disperse, in the name of the law, which after a great deal of confusion they did, threatening, however, to come back again and set fire to the work-yard in four places.

The steamers were obliged to leave off running down the river, the whole population below Pesth being in open rebellion.

With the exception of stormy and angry meetings between the parties, the period which immediately followed was tolerably tranquil; the last parcel of iron-work arrived at the end of June, and the first centre chain (Plate VIII.) was hoisted and connected on the 8th of July, all the tackle working well.

In spite of the greatest exertion in finishing the works, the political state of the country was such as to furnish daily anticipations of their proceedings being stopped. The Minister of War and several of the Generals were killed near Vienna, and the city bombarded, the Emperor and Court left, and everything was in the greatest confusion; it was by the merest chance that the workmen were prevented from being sent off *en masse* to recruit the army. When the state of affairs, however, would allow of work at all, the roadway beams (Plate XXVI.) were fixed in their places, and the upper parts of the towers finished. The rosettes were of cast iron, made in Hungary, as were also the pedestals on the footway, round the towers (Plate XIX.), and the cantilevers for the support of the balcony had been previously made by the same manufacturer, and were already fixed in their places. All the ornamental stone-work was executed by German and Italian carvers; they worked very rapidly, and in first-rate style, some of them making upwards of a pound a day on No. 2 pier.

1849. In December the occupation of Pesth by the Imperial troops took place; and as the details of the war are still fresh in the memory of most, it will be needful here to give only a summary of them, in so far as they affected the bridge.

On the bridge of boats being taken out, about the 22nd of December, the provisional government took the management of the bridge into their own hands, allowing the officials, &c., to pass by tickets, and forbidding the public under the severest penalties to force a passage, the platform being by this time nearly completed, and already sufficient for a passage across.

This lasted a few days, till the "great and sovereign people," as they styled themselves, forced a passage, by tearing down the barriers, maltreating the watchmen, &c., and setting all rule and order at defiance; and for several days the bridge was constantly crowded with people passing and re-passing, from morning till night, the authorities making no further attempt to keep order.

The provisional government now sent messages to the directors of the bridge, to prepare the approaches, &c. for the passage of troops and cavalry, and afterwards likewise for artillery, and this to be done under the severest penalties. All representations of the danger which might occur from the passage of troops over an unfinished bridge, were unavailing, and totally disregarded. This

being the case, therefore, the 5-inch longitudinal larch timbers (Plate XXVI.) were covered over with cross temporary planking, to save them as much as possible. After this had been done, the bridge was daily crossed by infantry and cavalry regiments, light and heavy artillery, baggage waggons, &c., and the whole of the Hungarian army at last retreated over it, and on the 5th and 6th of January the Imperial troops, to the amount of about 70,000 men, comprising nearly a dozen cavalry regiments, and 270 cannon, passed over it, and took possession of Buda-Pesth.

Whenever it was at all practicable, the work was proceeded with, although of course but little could be done when the platform and approaches were covered all the day with military, stores, &c. The foundry, where all the ornamental work had been made, was taken possession of for military purposes, and M. Ganz himself was obliged to cast cannon for them; so that, for months together, hardly a casting found its way to the bridge. The foundry of the Walz-Muhle, where all the roadway beams and larger work had been east, was also immediately shut up on the entrance of the Imperial troops. Some very large stones were brought from Sosküt during the winter, in spite of the difficulties attending the journey; one of them eontained 200 cubie feet English. This formed the head and shoulders of one of the lions on the Pesth side.

By the beginning of February the fortress of Buda was very strongly fortified, and several of the largest pieces of cannon planted, so as to sweep the platform of the bridge; a strong battery was also erected to defend the entrance.

About the 20th February, the General commanding the forees at Pesth issued an "ordre" that all workyards, shops, magazines, and materials of every kind whatsoever, that were on the Pesth side, should be pulled down and taken away before the night of the 11th of March at the latest, otherwise he should be compelled to resort to the most severe compulsory measures, and in that case that all eompensation would be denied to the Company. By working day and night, however, this "ordre" was obeyed, and by the night of the 11th the ground round the bridge was as clear as if the workyard, &c., had never existed. The iron and machinery was taken to Buda, and the stone, timber, &c., all removed to a distanee. Close to the bridge, and just about where

the engine for raising the chains stood, was built a military block-house for about 100 men, with blank walls piereed with holes for musketry—a dry ditch and palisading in front, and a eovert-way for the passage of soldiers behind.

After the passage of the Imperial troops on the night of the 29th April over the suspension bridge and bridge of boats, the latter was set fire to and eompletely destroyed, being previously covered with piteh, tar, and other eombustible matter. General Hentzi then eaused the whole of the 5-ineh platform timbers, as well as those forming the footpaths, to be cleared away, leaving the east-iron beams and trussing between Nos. 3 and 4 piers standing quite bare. He then caused four large eases, eontaining about 30 cwt. of gunpowder, to be placed on the 13th and 14th beams—eounting from No. 4—elose to the chains, two on eaeh side, with a train extending out to behind the toll-houses, with orders for the artillerymen to fire it if the Hungarians attempted to foree a passage—Pesth being already in possession of the insurgent troops. All direet eommunication now eeased between the two towns, the shores of both sides the Danube being lined with hostile troops, who soon began to fire on each other with small arms. One could see the artillerymen in the fortress standing by the eannon with lighted matches, ready to fire at a moment's notice. There were about 100 eannon directed against Pesth, mostly 24-pounders, with 64 and 120-pound mortars. The Buda workyard was strongly fortified with palisades and cannon, and lined with troops. Matters eontinued much in this state till the 4th of May, when the Hungarian army under General Georgy, about 40,000 strong, made its appearanee on the heights above Buda, and eommeneed bombarding the fortress.

As the Hungarians on the Pesth side had planted eannon above the bridge, and were making other preparations to attaek the troops in the Buda yard, General Henzi eommenced at about midday to bombard Pesth. The eannonade eontinued, with but little intermission, till about 12 o'eloek at night; and Mr. Adam Clarke, who was an eye-witness of all that oeeurred, on going home to his quarters at the above time, found that a 24-pound shot had smashed everything in his bedroom, while several smaller ones had made great havoe in the other rooms. The fortress continued to be bombarded without intermission, day and night, by the

Hungarians till the 9th, and several attempts had been made without success to take the Buda yard and works by storm. On that day preparations were again made, but on a larger scale, to open a fire on the Buda yard from Pesth. In consequence of these preparations being observed from the fortress, a tremendous fire was opened on Pesth with shells and grape-shot; this lasted only an hour, but did immense damage and set fire to several houses.

The whole population of Pesth, with very few exceptions—of which Mr. Adam Clarke was one—fled into the country round about. The "Stadt Walchen" was quite an encampment of civilians, where about 80,000 inhabitants of Pesth, of all ages and ranks, were encamped in the open air,—while for the few who remained in the town it was a difficult matter to procure food, of even the coarsest description.

Up to this time, the bridge, as far as we could see, had suffered little or nothing. One of the $\frac{3}{4}$ columns of the lower toll-house on the Pesth side had been shattered by a shot, and some of the setting machinery damaged, but that was all. The Hungarians, however, had now got battering artillery from Comorn (which had fallen into their hands at the beginning of the outbreak), and were making sad havoc in the fortress—the whole of the heights from Blocksberg where the Observatory stands (see map) up to Altffen being covered with batteries playing day and night incessantly. This continued up to the evening of the ever-memorable 13th of May, when, as if to show that the previous firing had been mere child's play, General Hentzi opened such a fire of shot and shells on Pesth as will never be forgotten by those who witnessed it. From 7 o'clock in the evening till 12 midnight, balls, bombs, and rockets fell like a hurricane of fire over the devoted city; by 9 o'clock it was on fire in thirty-two different places—and the thunder of the cannon, the crashing and hissing sound of the shells as they fell in hundreds, and above all the roar of the flames, which seemed determined to leave not a vestige of poor Pesth standing, formed a scene to the senses impossible to be described.

The next morning the city, indeed, presented a sad sight. After the cannonade ceased, the progress of the flames had been stopped; but half the city appeared in ruins, the houses all more

or less injured from the shot, the glass from the windows filling the streets, and the pavement torn up by the shells. The town and fortress of Buda was also in much the same condition, great numbers of houses being burnt and destroyed, as well as the Palace of the Palatine, which burnt for four days and nights.

At last, on the night of the 20th of May, the walls of the city were stormed at all points by an overwhelming force; and after a bloody and severe struggle, in which General Hentzi lost his life, the fortress was taken; and on the morning of the 21st, the Hungarian colours appeared floating from the towers. Between 6 and 7 o'clock that morning, and after all was lost, with the exception of the Buda workyard, which was still held by the brave General who commanded them, he—for what reason is not known—set fire to the powder on the bridge with his own hands, blowing himself and about 80 feet of the skeleton of the platform to atoms; after this, all resistance ceased. Five of the beams were blown to pieces, and three were broken, but still hanging. The troops broke into the offices and magazines at the works, and destroyed much valuable property, and it was with the greatest difficulty that the papers and drawings were saved from destruction.

The Hungarian General Georgy now came and gave orders for the bridge to be repaired for the passage of troops; and as there were several spare beams in the yard, this was done in four or five days.

On examining the state of the bridge it appeared, that although many shot had struck the bridge, there was but *one* which had done damage of any consequence. This shot, a 24-pounder, and fired apparently from the Blocksberg, had unfortunately taken effect on one of the long-forged links which connected with the curved set of the upper chain on the Buda side (see Plate) of No. 3 pier; the ball struck the outer bar about 12 inches from the head, and forced it close up to the second bar, which, however, was unhurt; there were in the damaged bar several cracks or rents from the upper edge downwards, one of which cracks extended to the depth of 3 inches. It was almost impossible to replace the damaged link owing to its being one of a set of ten, thereby rendering it necessary to remove the outer links from each of the adjoining sets before the faulty link could be got

at; and one of the sets, as before stated, are the curved bars in the tower itself. The bar struck was reduced, as was supposed, about one half in strength, and the means adopted to remedy the accident will be hereafter stated.

The bridge continued open for the military and a part of the public till the 30th of May, when it was closed, and the works commenced again at all points; and as the authorities stated that the progress should not again be interrupted, a beginning was made to lay the wood pavement on the platform.

The works now proceeded for some time in quiet and good order, great difficulty being, however, experienced in procuring workmen, several thousands being employed in destroying the fortifications at Buda at very high wages. About the end of June, in consequence of the advance of the Imperial troops upon Raab, orders were again received to put the bridge in a state for the passage of troops and artillery; the work was therefore again, in great part, suspended, and the platform covered with temporary planking, to save the longitudinal timber as before.

On the 7th of June, after the insurgents had been beaten at Raab, the Polish General, Dembinsky, sent a detachment of sappers and miners, with pitch and other combustibles, to deposit them in such positions on the woodwork of the bridge as would insure its speedy and certain destruction, as soon as the retreating Hungarian army had passed over, in order to prevent the Imperial troops from following. In answer to the remonstrances of Mr. Adam Clarke, General Yörök said it was with a heavy heart he set about the destruction of such a work, but that his orders were imperative. Mr. Adam Clarke then went to General Dembinsky himself, and made a most energetic remonstrance, assuring him that the burning of the bridge was an unnecessary piece of vandalism, which would sully his name and reputation for ever, and that the bridge could soon be made impassable for four or five days, the longest period possible to prevent the crossing of the Imperial troops, as a ponton bridge could be thrown across in less than that time. At last the old General thought proper to listen to reason, and sent a detachment to assist and, if necessary, to compel the workmen to make the necessary preparations. All hands were now set to work to take the screws out of the beams, &c.; and the next day, Sunday the 8th, after the troops had

all passed over, the 5-inch timbers were again cleared away between Nos. 3 and 4 piers, with about 80 feet of the skeleton of the platform, and leaving an opening of that extent where the chains were the only communication. The beams and iron-work were lowered into two barges, which were scuttled and sent adrift.

The period at which it had been arranged that the opening of the bridge should, if possible, take place, was the 1st of March, 1849, and every exertion had been made with this intent; and from the great progress made in every part of the work, there can be no doubt that it would have been finished, that is to say, open for traffic, by, if not before, that time. The unfortunate occurrences which took place at the very period, in which a short continuance of the exertions, then being made, would have insured its speedy completion, of course prevented the bridge being opened either at that time or at any part of the summer. For months the bridge, its works, and magazines were in use for military purposes. Well and bravely, in the opinion of all, it sustained the severe ordeal to which it was exposed, and great was the admiration expressed of it by all who witnessed the occurrences at Pesth, where it was popularly styled "the eighth wonder of the world."

During the war the bridge had been tested by the passage of numerous troops of the different armies of infantry, cavalry, and artillery, with heavy waggons and the usual accompaniments crowding the entire surface of the platform, not only for a day, but for weeks together, day and night, and this when the trussing and bracing, which adds so much to the strength of the platform, was for the most part not erected.

Mr. Tierney Clark made his annual visit to Pesth in the autumn of this year, and after a close examination of the entire structure, found that the bridge had sustained no damage whatever, with the exception of the link before mentioned in one of the top chains. After consideration, Mr. Clark came to the conclusion, that as great delay and expense must result if the damaged link were removed, the best plan would be to fix a thin link beside the damaged one, and also another on the opposite side, the section of these additional links together being greater than the damaged one. To replace the link would have occasioned great expense, whereas the two additional thin bars cost only 10*l.* 4*s.* On

Mr. Clark's arrival on the 21st of September, the state of the works was as follows, viz. :—

The entire platform, carriage and footways, were finished ready for traffie; the toll-houses also perfected. The lamps and pedestal for the toll-gates (Plate XXXVI.), as originally intended, were fixed; but Mr. T. Clark, fearing that on some oeeasions accidents might occur, altered the position to that shown in Plate XXXII.; it was in the first instance fixed between the toll-houses, as in most similar structures. The lamp and pedestal at end of wing-wall (Plate XXXVII.) was also fixed, as well as the majority of those on the pedestals round the galleries or balconies round the towers (Plate XVIII.), for foot passengers. The fence separating the foot and earriage ways, from the head of the retaining pier to the toll-houses, was in a state of forwardness, but not finished, being delayed for the want of castings and smith's work, owing to the late disturbanees. The carriage road on the Buda side had yet to be made by the town authorities, aecording to agreement, as also that on the Pesth side.

There were, besides, other works to be finished, in no way interfering with the traffie on the bridge, before it eould be considered eompleted. No. 1 cofferdam was nearly down; No. 2 in progress; and No. 3 could not be taken away until the concrete and rubble work between the water and inner rows of piles had been put in. No. 4 dam had been entirely taken away.

The bridge was opened for general traffie on the 20th of November, 1849.

Thus was finished Pesth Suspension Bridge, a work which, in its eonstruction, encountered probably more difficulties than any strueture of a similar kind in existenee. The magnitude of the river over which it is thrown, its depth, nature of bed, and veloeity of current, created the misgivings, at one time almost universal in Hungary, that no permanent communication could ever bc established across the Danube between Buda and Pesth. The moral difficulties to be overcome, no less than the physical obstacles, were very great. Pride, prejudice, and jealousy had eaeh to bc eneountered, so universal against the objeet at one period, that nothing less than the extraordinary energy and perseverance shown by Count Széchenyi could have withstood their evil effects, and few would have made the attempt.

The benefits derived from its construction are incalculable: two cities of great size, opulence, and resources have, by its means, been brought into immediate connection, where before existed only an uncertain, and occasionally perilous, means of communication—not to speak of the great addition made to their attractions by the suspension bridge as a structure of art. Good will no doubt accrue by the increased means of transit, and consequently further and extended commerce. Hungary is gradually becoming more known and appreciated, and with much advantage to the development of her natural resources. By increased intercourse with other nations, her inhabitants may be infused with more energy and less prejudice, while the good and sterling qualities possessed by many of her principal men, as by the great and good Count Széchenyi, will be discovered and admired. He is now, alas, it is to be feared, morally lost to his country and friends for ever; but his great labours for the advantage of Hungary remain, and their good effect is becoming daily more perceptible.

ADDITIONAL PARTICULARS.

The total cost of the bridge up to the end of December, 1849, including everything, excepting the expense of taking tolls, lighting, and watching, was 6,220,428 florins sterling (622,042*l.*) Interest and purchase of land amounted to 1,519,294 florins (151,929*l.*) The old materials and machinery valued at about 100,000 florins (10,000*l.*)—giving the total cost of the bridge itself 4,601,134 florins (460,113*l.*)

The greatest observed difference in the versed sine of the chains of the centre opening was $14\frac{3}{4}$ inches; the greatest degree of cold at which observations could be taken was 20 degrees below zero, and the greatest heat 34 degrees above (Reaumur)—leaving a difference of 54 degrees.

The prices paid for the different kinds of labour were as follows:—

The wages of labourers at the commencement of the work varied from 28 to 32 kreutzers per day; they eventually rose to 34 and 40 kreutzers.

	At the commencement	At the end.
Carpenters and bricklayers . .	40 to 48 krs.	50 krs. to 1 fl. 15 krs.
Italian carpenters	2 fls. 0 krs.	1 fl. 20 krs.
Stone masons	1 fl. 20 „	1 fl. 40 krs. to 2 fls.
Granite masons	1 „ 40 „	2 fls.
Pattern makers	1 „ 0 „	1 fl. 20 krs.
Setters	1 „ 15 „	2 fls.
Smiths, firemen, etc. . . .	1 „ 20 „	1 fl. 40 krs. to 2 fls.
Hammer-men	0 „ 50 „	1 fl. 5 krs.
Fitters	1 „ 20 „	1 fl. 40 krs. 2 fls.
Boat and bargemen . . .	0 „ 50 „	1 fl. 6 krs.

[The above prices refer to a day of ten hours.]

THE PRICE OF BUILDING MATERIALS, ETC., AS FOLLOWS:

(ALL DELIVERED ON THE WORKS.)

	fls.	krs.
Fifteen-inch square baulk timbers, in length from 40 to 80 ft., per foot run . . . . . 30 krs. to	0	40
Oak, same lengths and size . . . . . 1 fl. to	0	50
Square larch in lengths from 40 to 60 ft.	2	0
Round do. do. per cubic foot	1	0
Common round timbers, 50 ft. long, and averaging 12 inches at the butt . . . . . each	3	0
Ditto do. 60 ft. long, and averaging 18 to 20 inch. at the butt . . . . . 16 fls. to	18	0
[This applies to the timber from Austria and Bavaria. The Hungarian timber from the Waag being of much inferior quality, cost 25 to 30 per cent less.]		
Four-inch. planks 18 ft. long, 12 inch. broad (Bavarian) . each	1	36
Three ditto ditto ditto . „	1	12
Inch boards ditto ditto . . „	0	30
Rubble stone per cubic klafter (216 feet)	8	0
Granite, including all expenses	3	0
Sand, fine and free from impurities, per cubic klafter . . .	12	0
Gravel, best 8fls. Ditto, got by dredging, per klafter . . .	4	0
Hydraulic lime, ground for use, per cubic foot.	0	50
Coal for smiths, per Vienna centner	0	40
Charcoal, per Vienna metizen	0	24
Coal for steam-engines, per centner	0	24
Hard Soskût stone, per cube foot	0	40
Soft ditto ditto	0	30
Waitzen ditto ditto	0	34

[The above are the averages including all expenses.]

Waitzen quarry was distant 25 English miles.

Soskût quarry was distant 16 English miles.

Mauthausen granite quarry was distant 270 English miles.

No. 1 dam was commenced and the first pile was pitched on the 28th July, 1840; finished August 6th, 1842.

No. 2 dam was commenced and the first pile pitched May 1st, 1841; finished August 6th, 1842.

No. 3 dam was commenced and first pile pitched April 8th, 1842; finished April 4th, 1845.

No. 4 dam was commenced and first pile pitched May 12th, 1842; finished January 5th, 1844.

The following is the number of piles in each dam, and the per-centage drawn and re-driven:—

No. 1 dam, 1868 pitched, 509 drawn=38 per cent. drawn and re-driven.(?) This large per-centage is accounted for by the fact that a large quantity of the oak timber just procured proved unfit for driving.

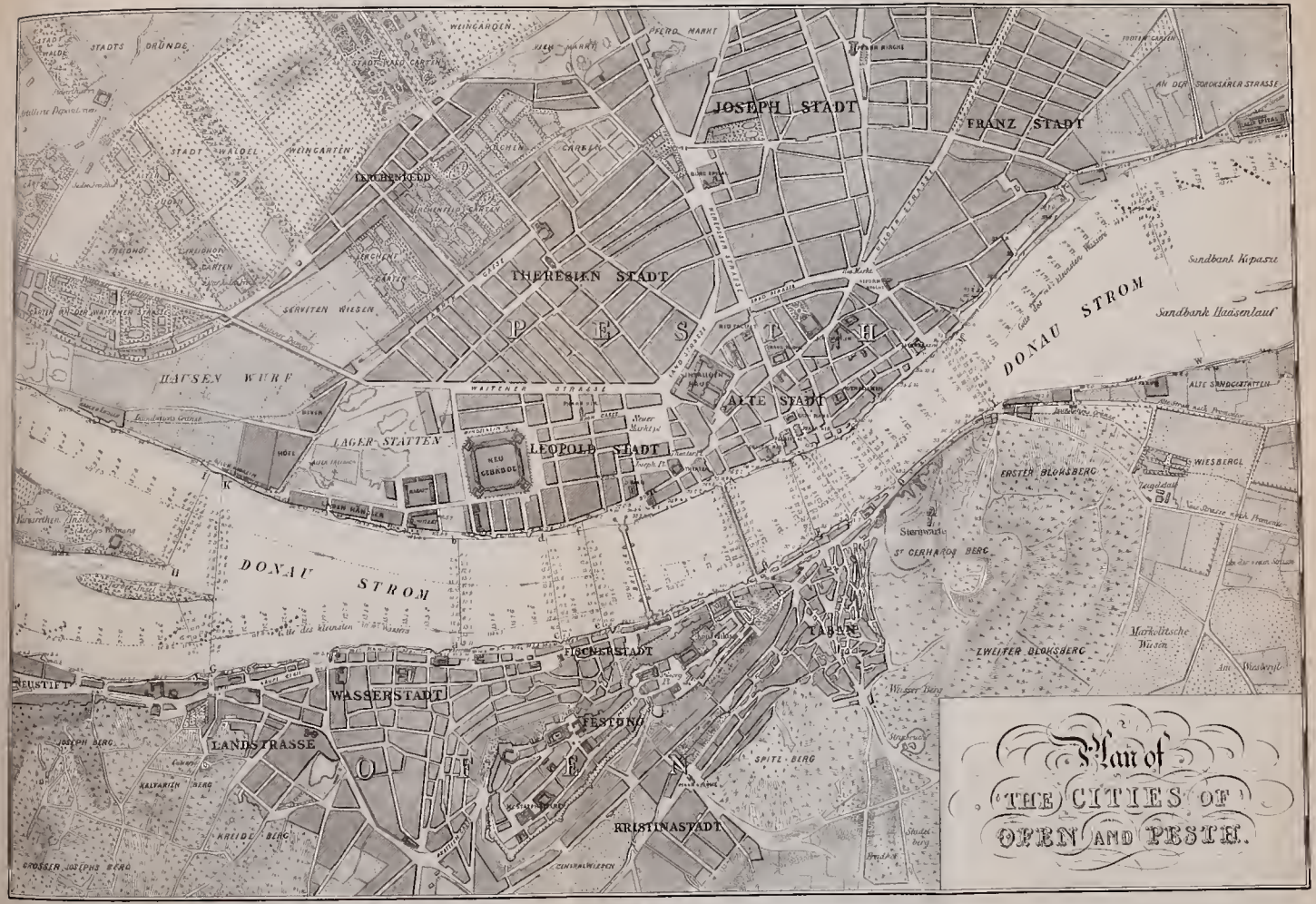
No. 2 dam 1100 pitched, 77 drawn—7 per cent. drawn and re-driven.

No. 3 dam, 1227 pitched, 174 drawn—16½ per cent. drawn and re-driven.

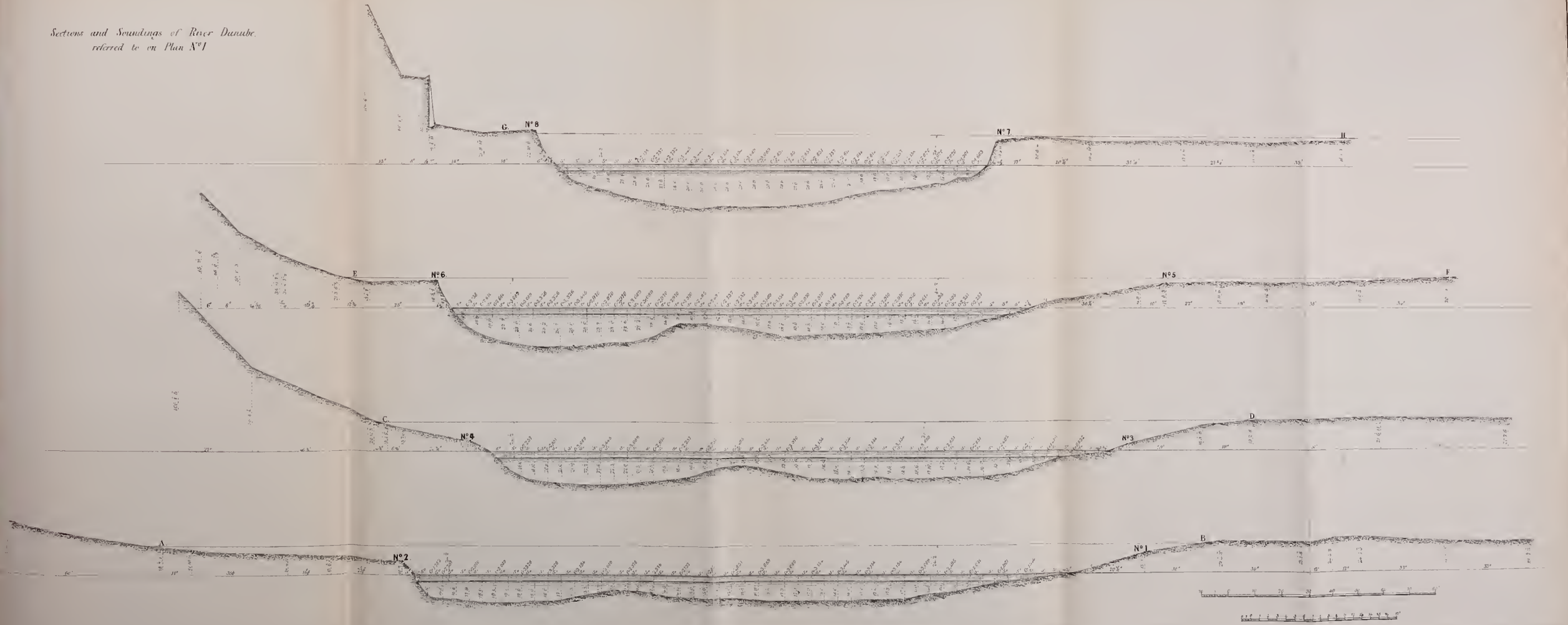
No. 4 dam, 1029 pitched, 32 drawn; about 3 per cent. drawn and re-driven.

THE END.

BRADBURY AND EVANS, PRINTERS, WHITEFRIARS.


JOSEPH STADT
FRANZ STADT
THERESIEN STADT
ALTE STADT
LEOPOLD STADT
PESTH
DONAU STROM
DONAU STROM
HAUSEN WURF
LAGER STATTEN
WASSERSTADT
FISCHERSTADT
FESTUNG
OFEN
TABAN
KRISTINASTADT
LANDSTRASSE
ERSTER BLOKSBERG
ZWEITER BLOKSBERG
WIESBERGL
SPITZ BERG
KREIDE BERG
KALVARIEN BERG
JOSEPH BERG
GROSSER JOSEPHS BERG
Sandbank Kopasz
Sandbank Hasenlauf
Plan of
THE CITIES OF
OFEN AND PESTH.

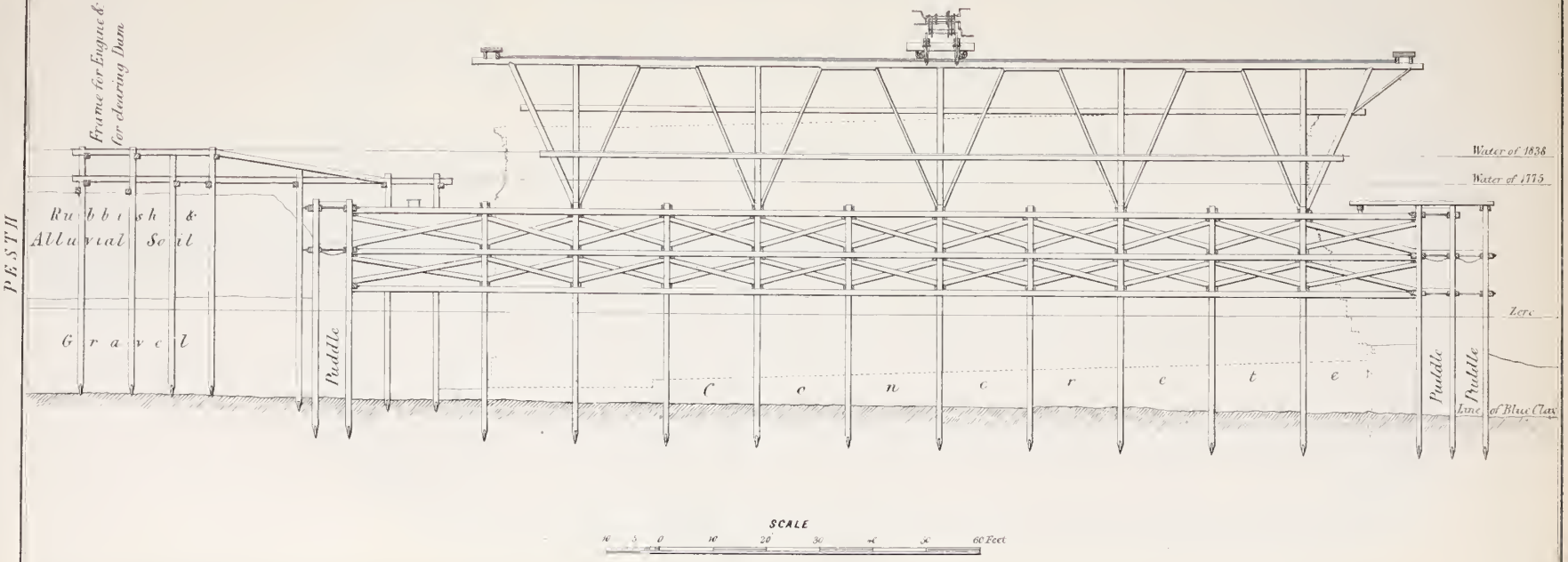
Sections and Soundings of River Danube referred to on Plan N°1



Published by John Weale ... 1862

PESTH

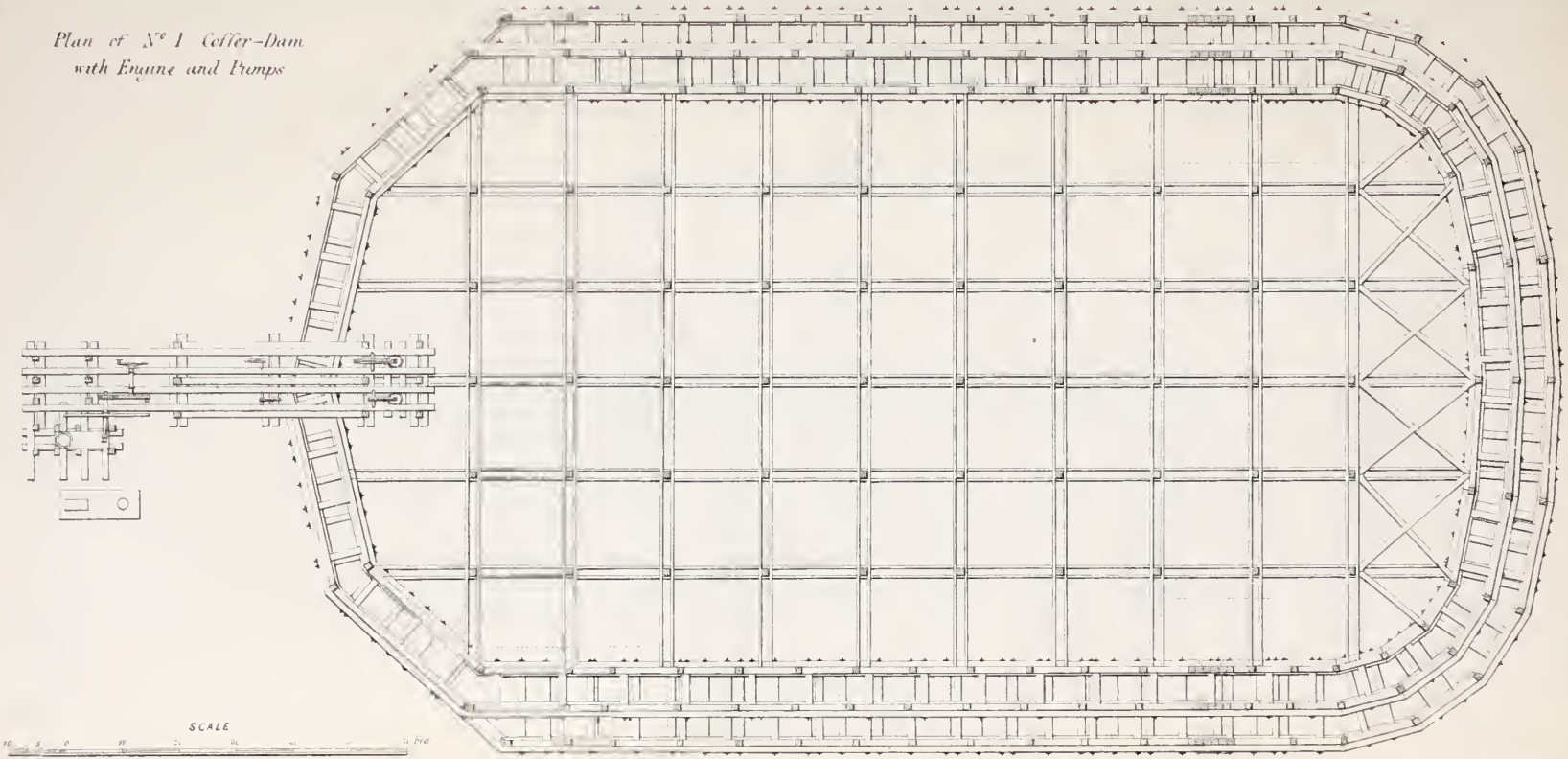
Longitudinal Section of Framing of Nos 1 & 4 Coffer-Dams for Fixture Piers with Traveller for raising Stone.



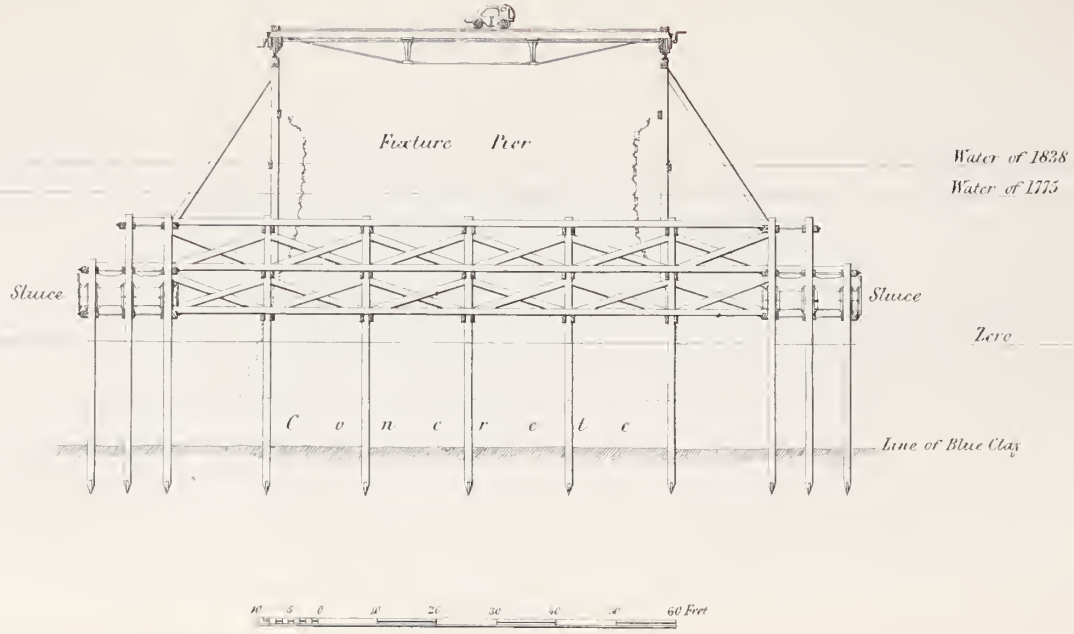
Published by [illegible] Jan. May [illegible]

Pl. 3

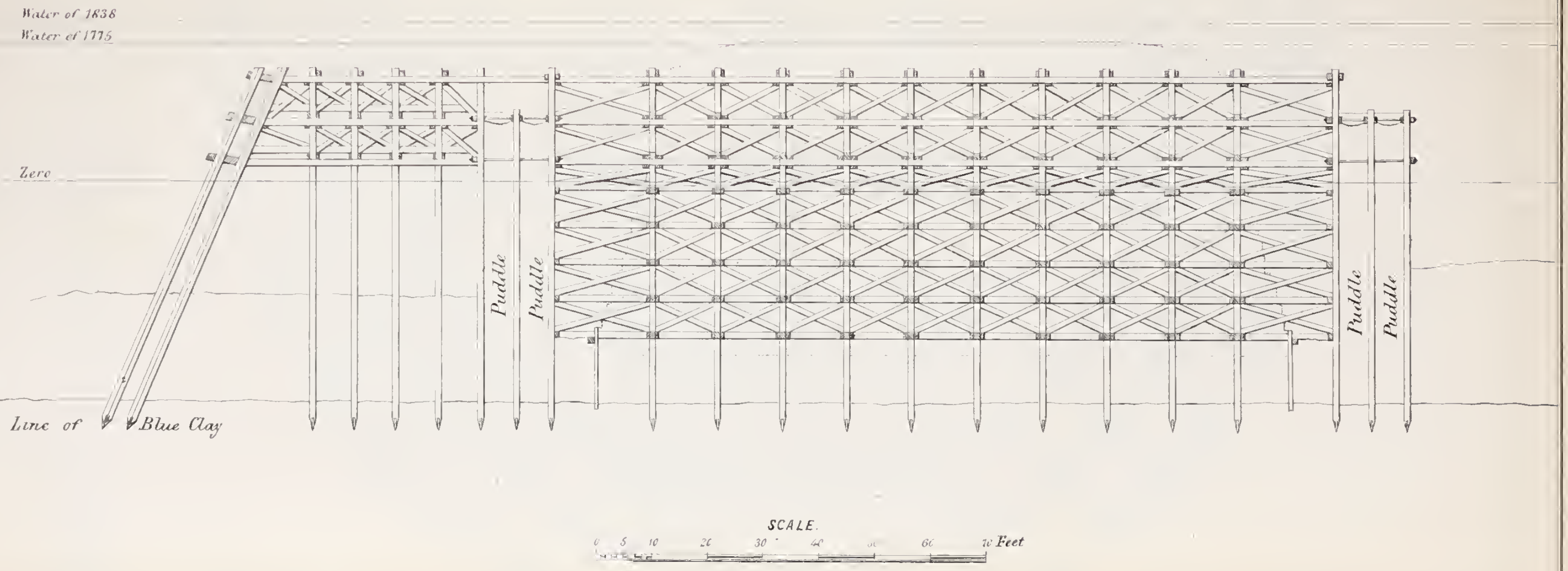
Plan of N° 1 Coffer-Dam with Engine and Pumps



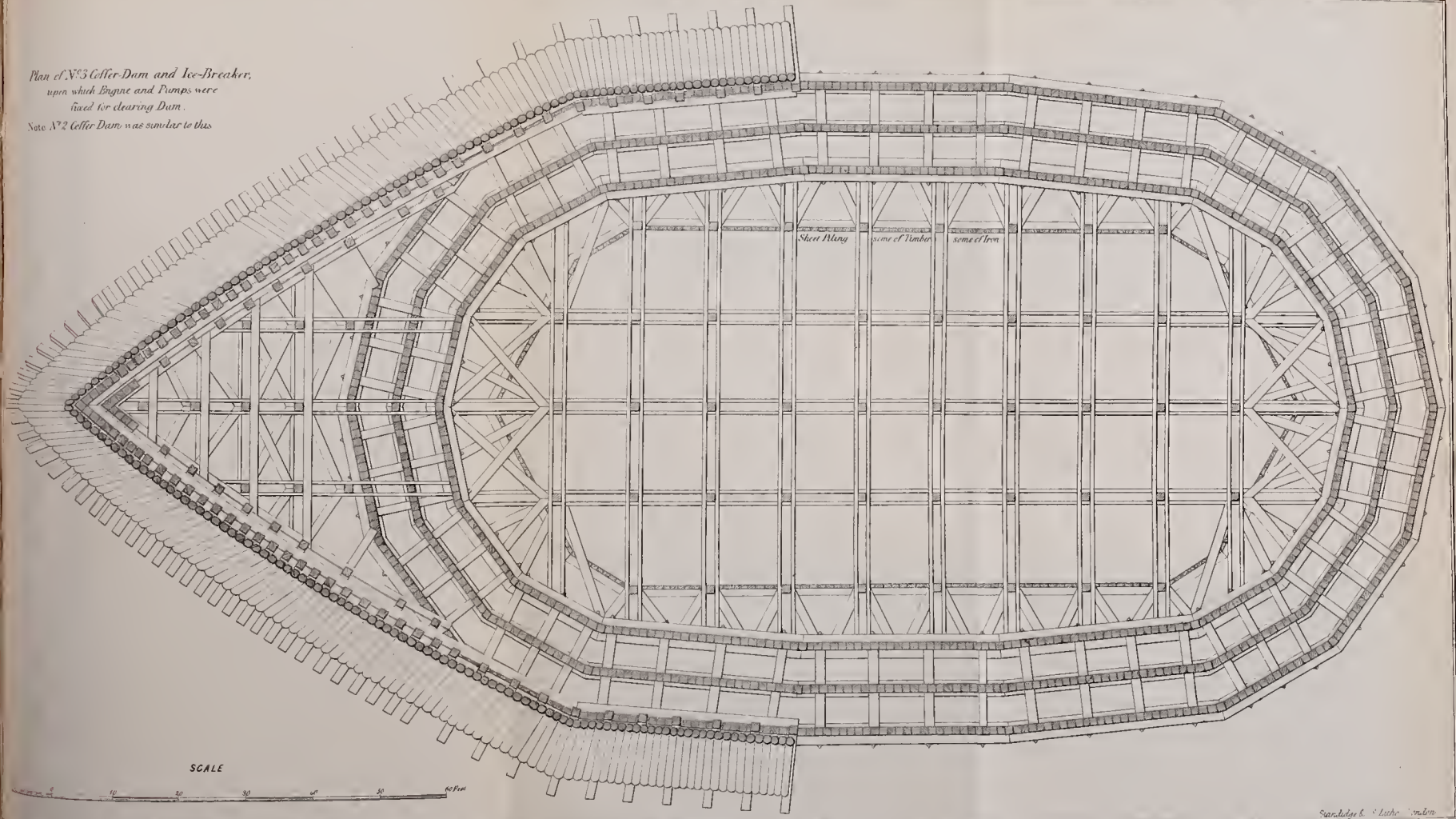
End View of Fixture Piers
with
Transverse Section of Framing of Coffer-Dams for Nos 1 & 4



Longitudinal Section of N^os 2 & 3 Coffer Dam and Ice-Breaker.



Plan of N°3 Coffer-Dam and Ice-Breaker,
upon which Engine and Pumps were
fixed for clearing Dam.
Note N°2 Coffer Dam was similar to this.

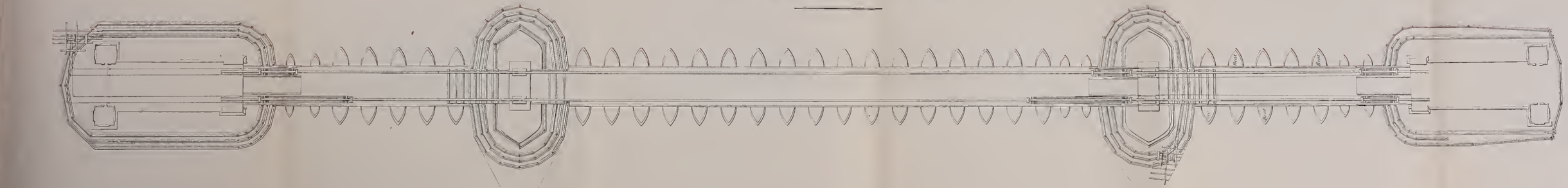


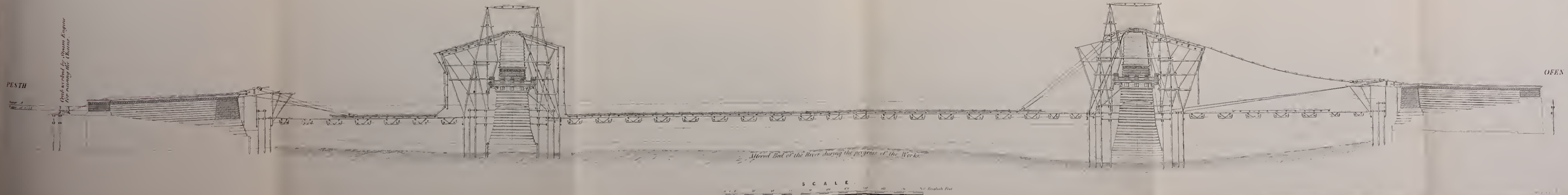
Standidge & Fisher lithn.

Published by John Weale London. May 1st 1852

PLAN AND ELEVATION,

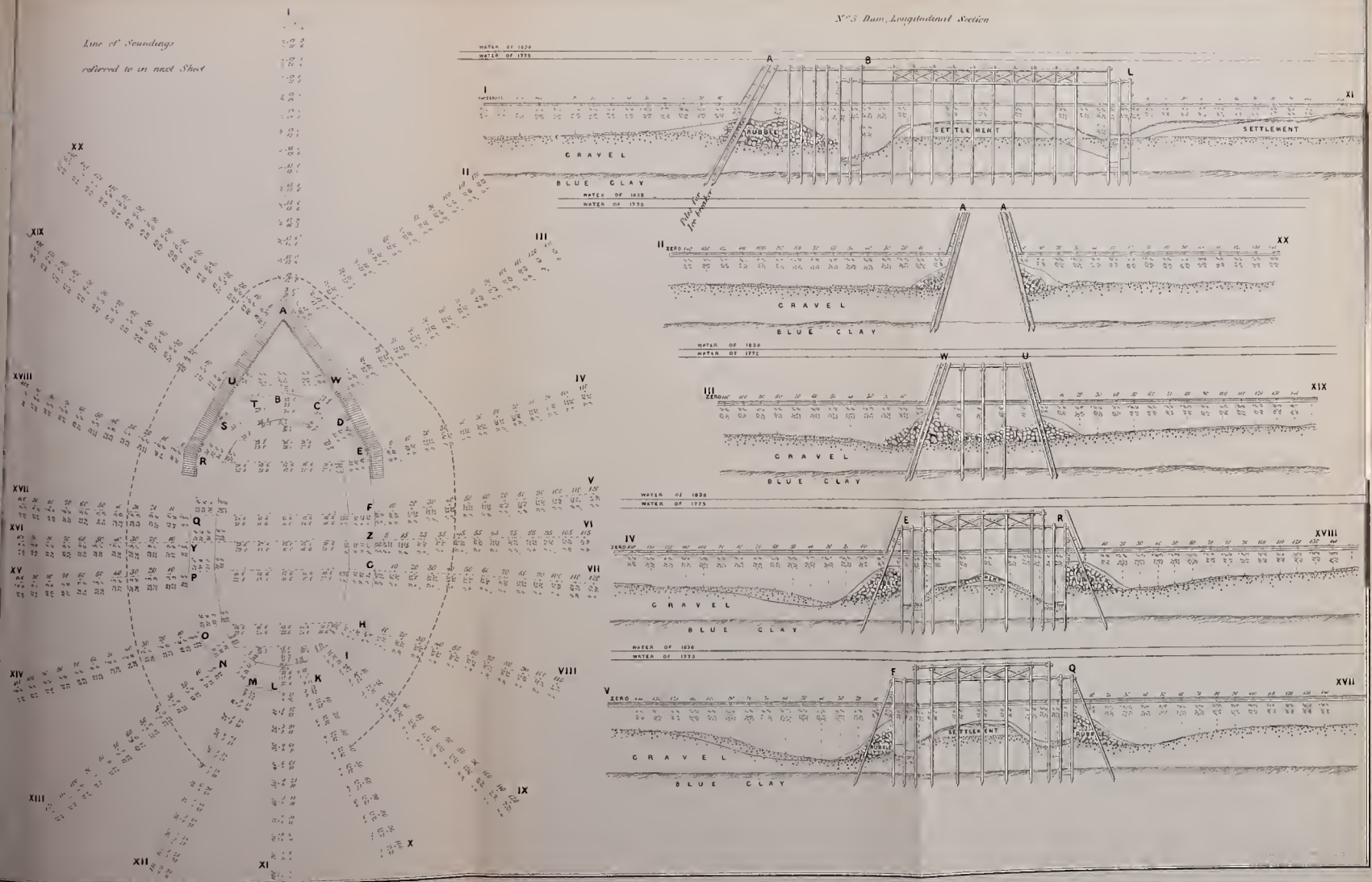
SHEWING THE CONSTRUCTION OF THE SCAFFOLDING
AND THE MANNER OF HOISTING THE CHAINS.





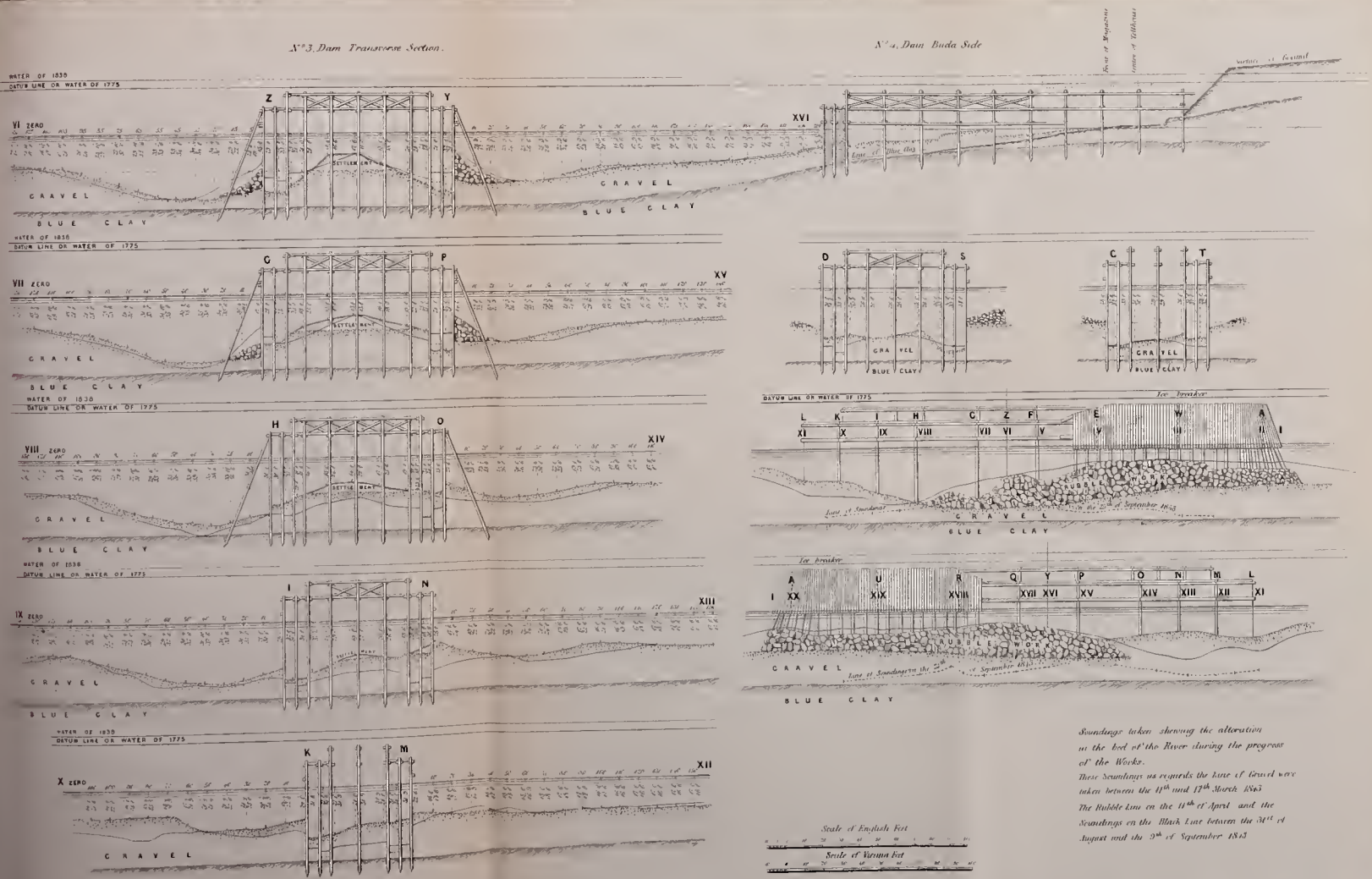
Line of Soundings
referred to in next Sheet

N°3 Dam, Longitudinal Section



N°3. Dam Transverse Section.

N°4. Dam Buda Side



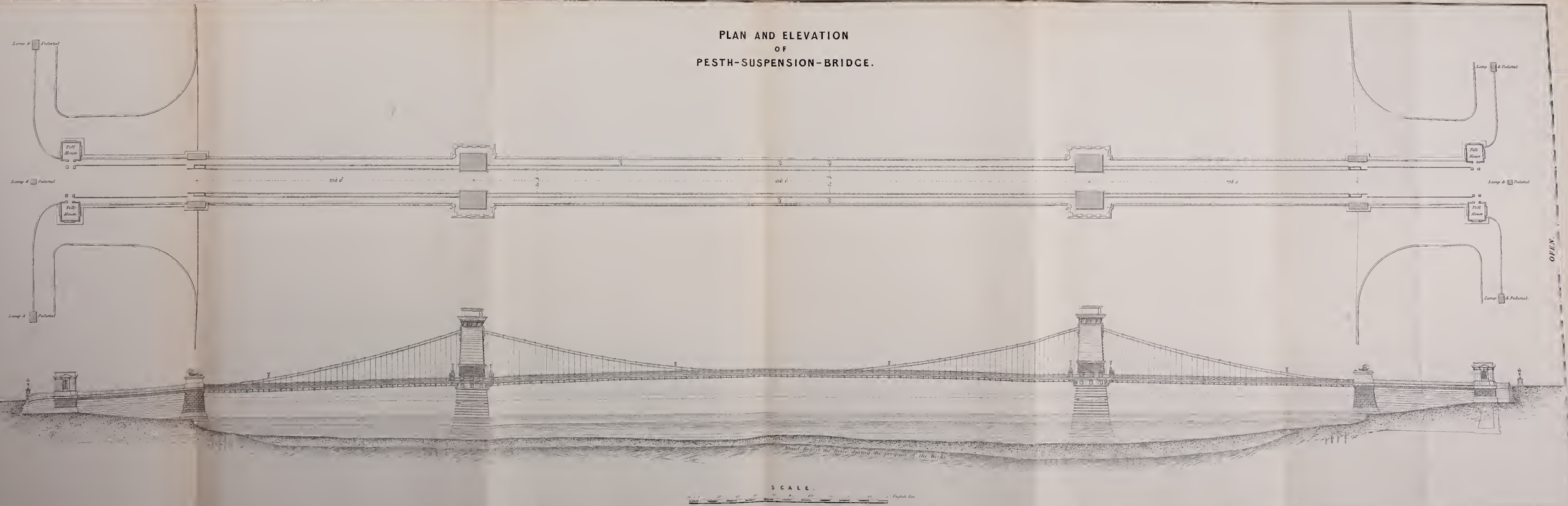
Scale of English Feet

Scale of Vienna feet

Soundings taken shewing the alteration in the bed of the River during the progress of the Works.
These Soundings as regards the Line of Gravel were taken between the 11th and 17th March 1843
The Rubble Line on the 11th of April and the Soundings on the Black Line between the 31st of August and the 9th of September 1843

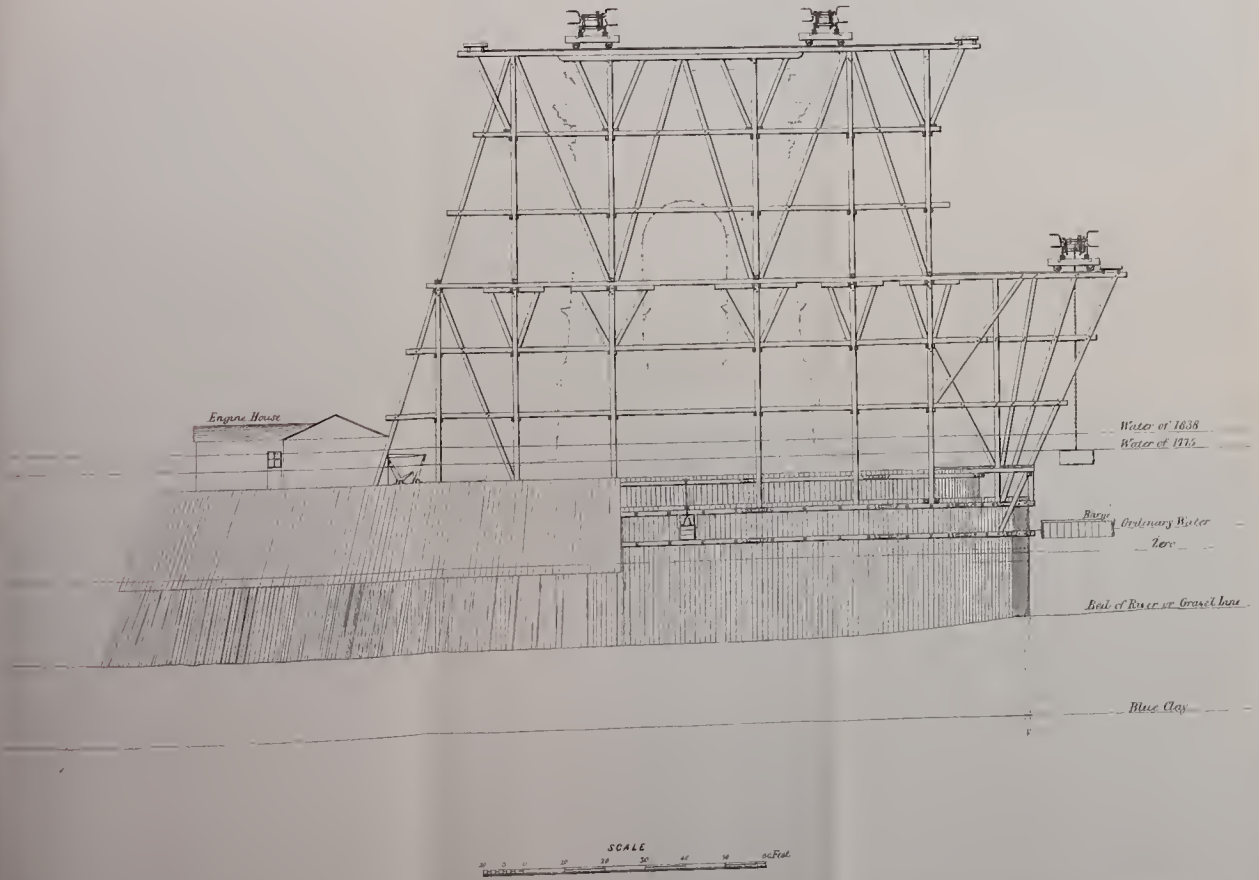
published by

PLAN AND ELEVATION
OF
PESTH-SUSPENSION-BRIDGE.



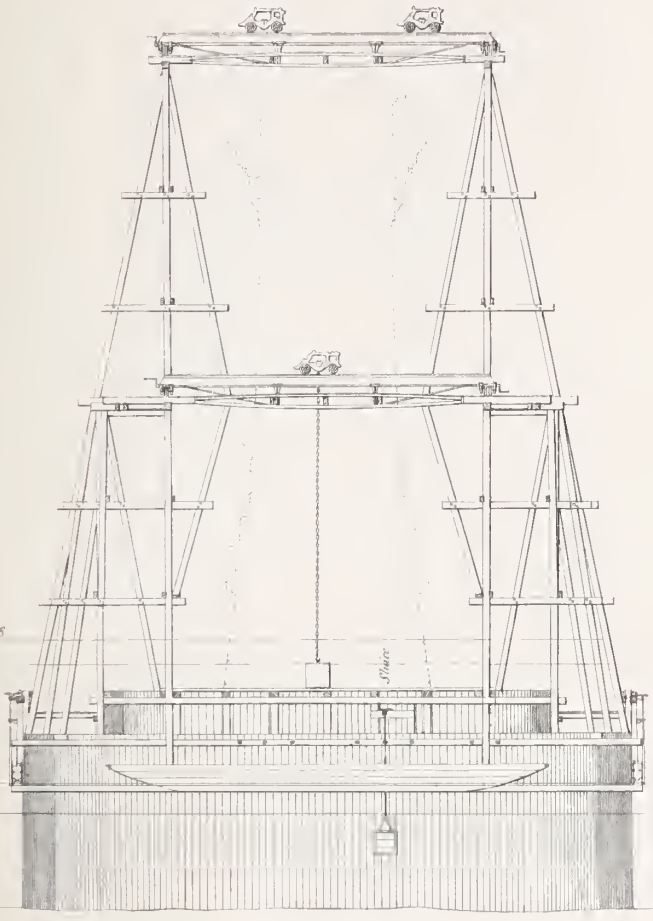
SCALE.

Elevation of Nos 2 & 3 Coffer Dams with Framang and Travellers for raising and setting Stone.

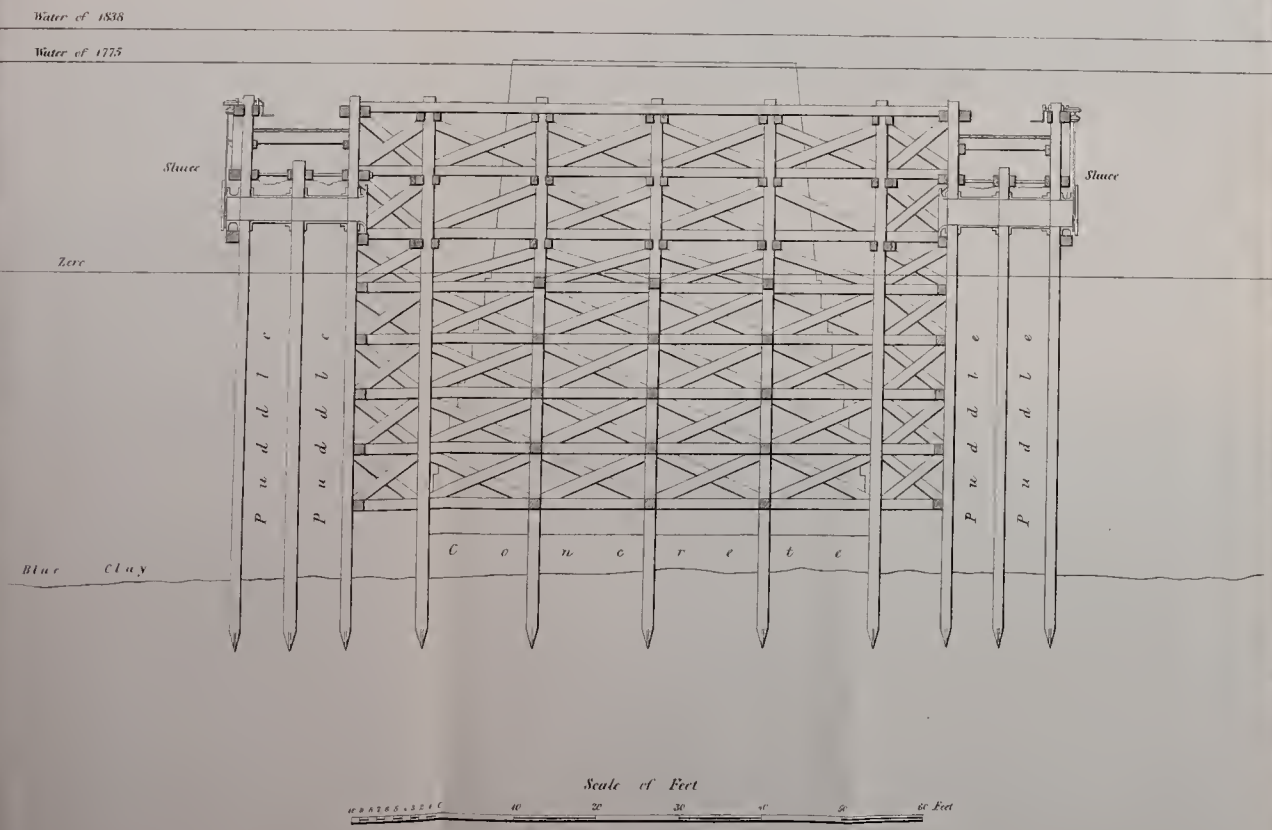


Published by ... 1839

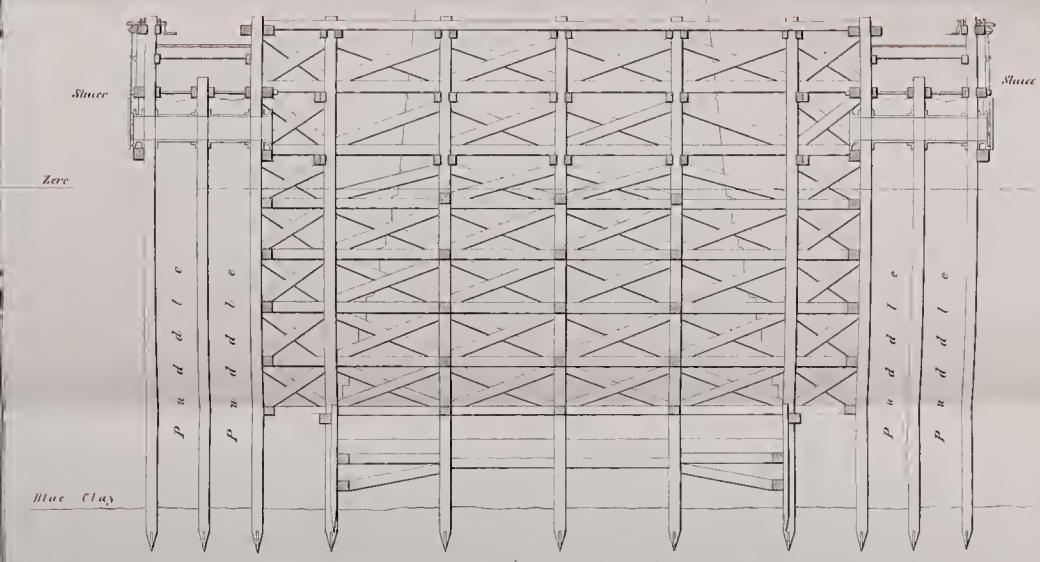
End View of Nos 2 and 3 Coffer Dams, with Framing and Travellers, for raising and setting Stone.



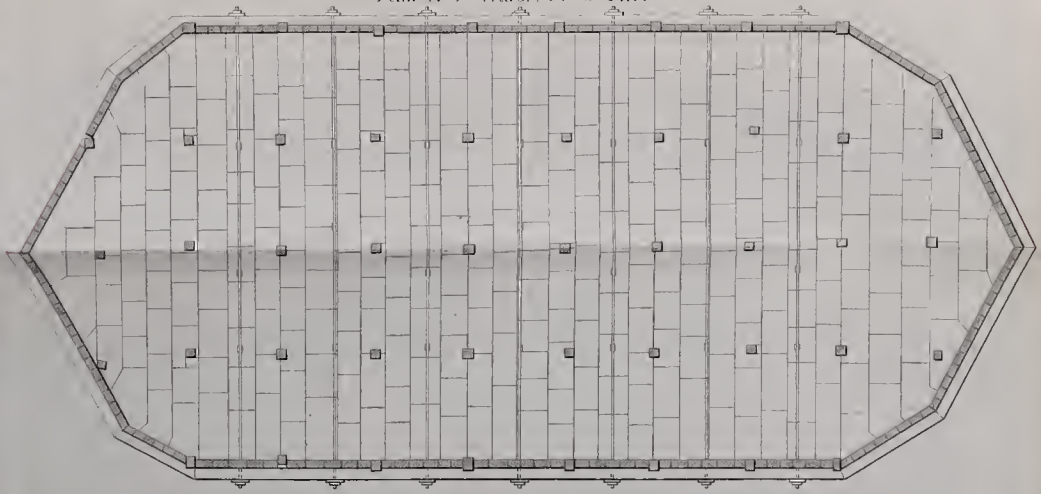
Transverse Section. N°. 2 Coffer Dam.



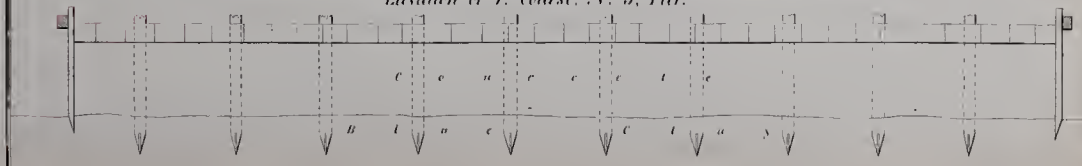
Transverse Section, N° 3 Coffer Dam.



Plan of 1st Course, N° 3 Pier.



Elevation of 1st Course, N° 3, Pier.



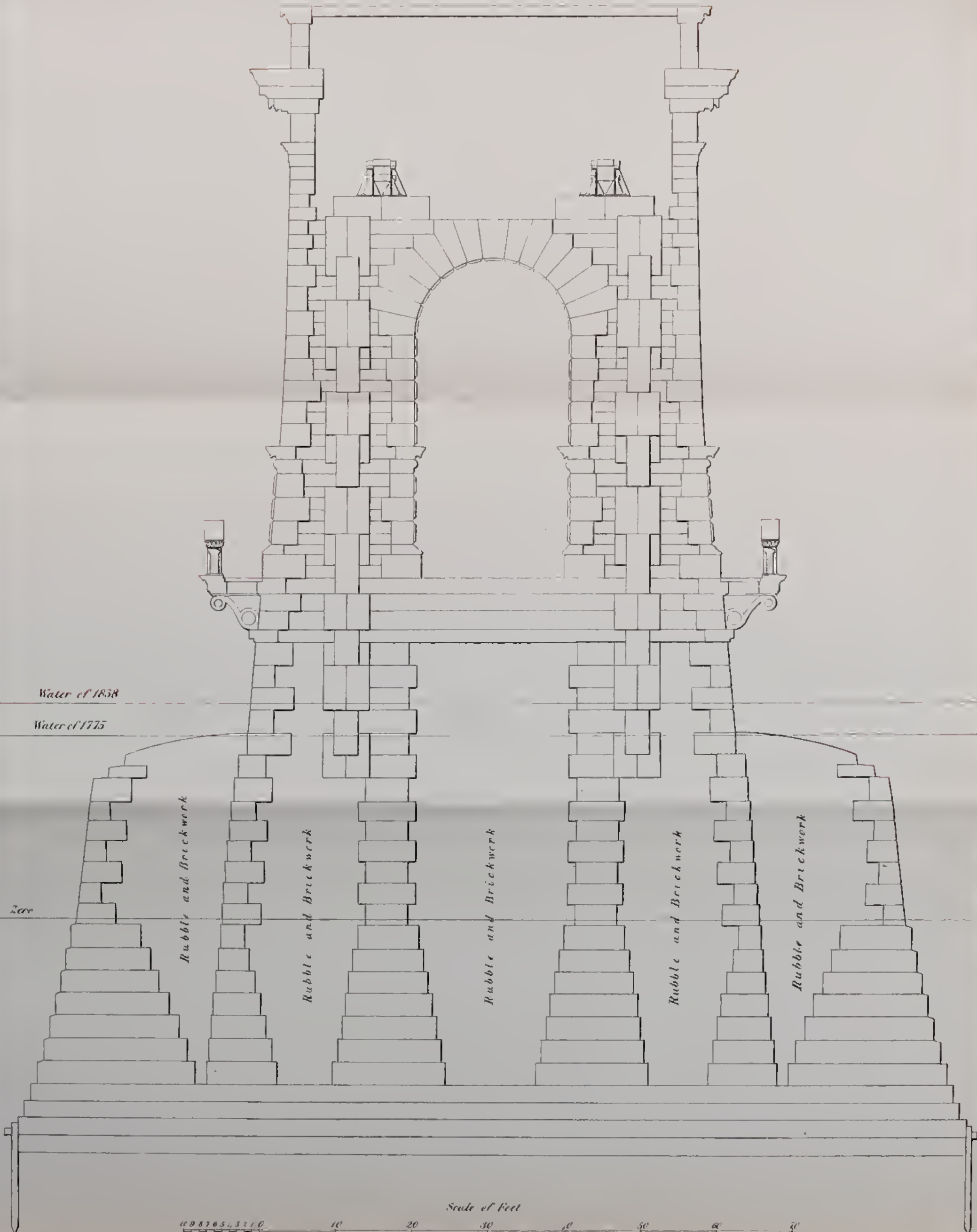
Scale of Feet

0 10 20 30 40 50 60 Feet

Published by John Weale, London, May 1st 1841.

VERTICAL SECTION OF N^{os} 2 AND 3 PIERS

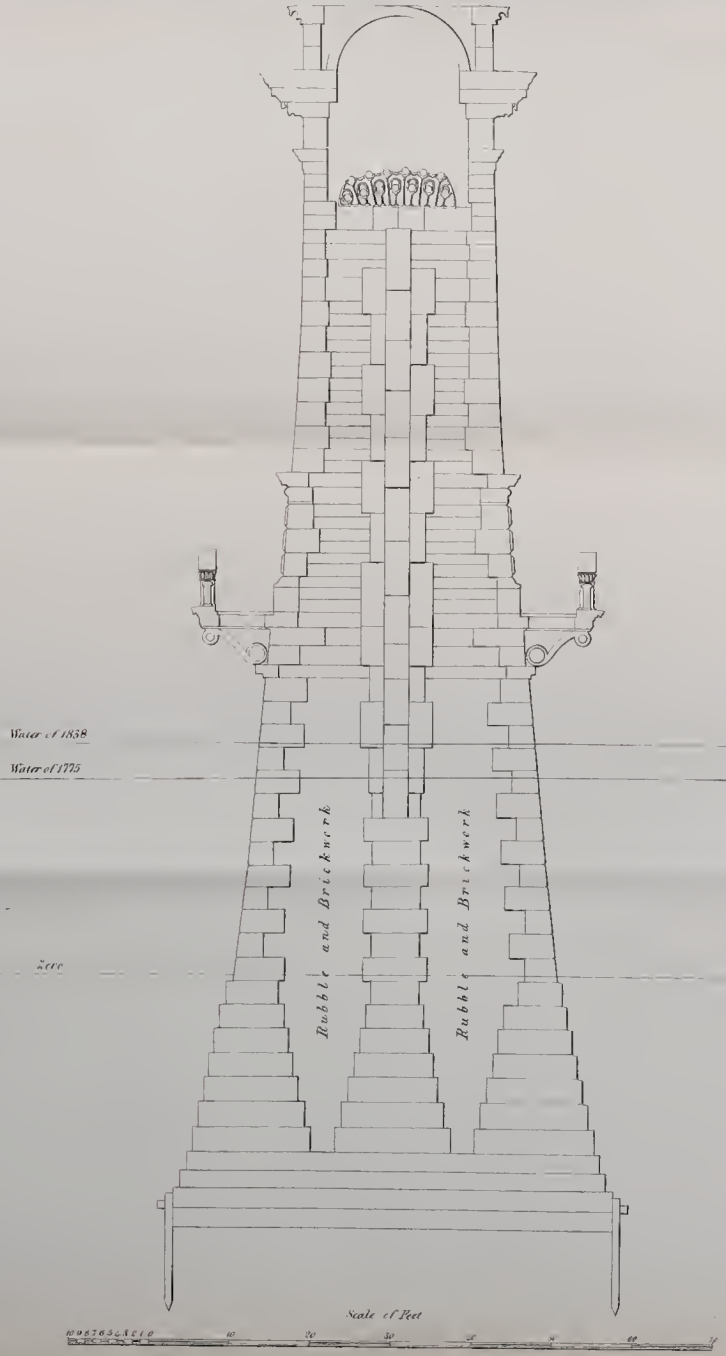
SHEWING VERTICAL BOND-STONES.



Standidge & C° Litho London

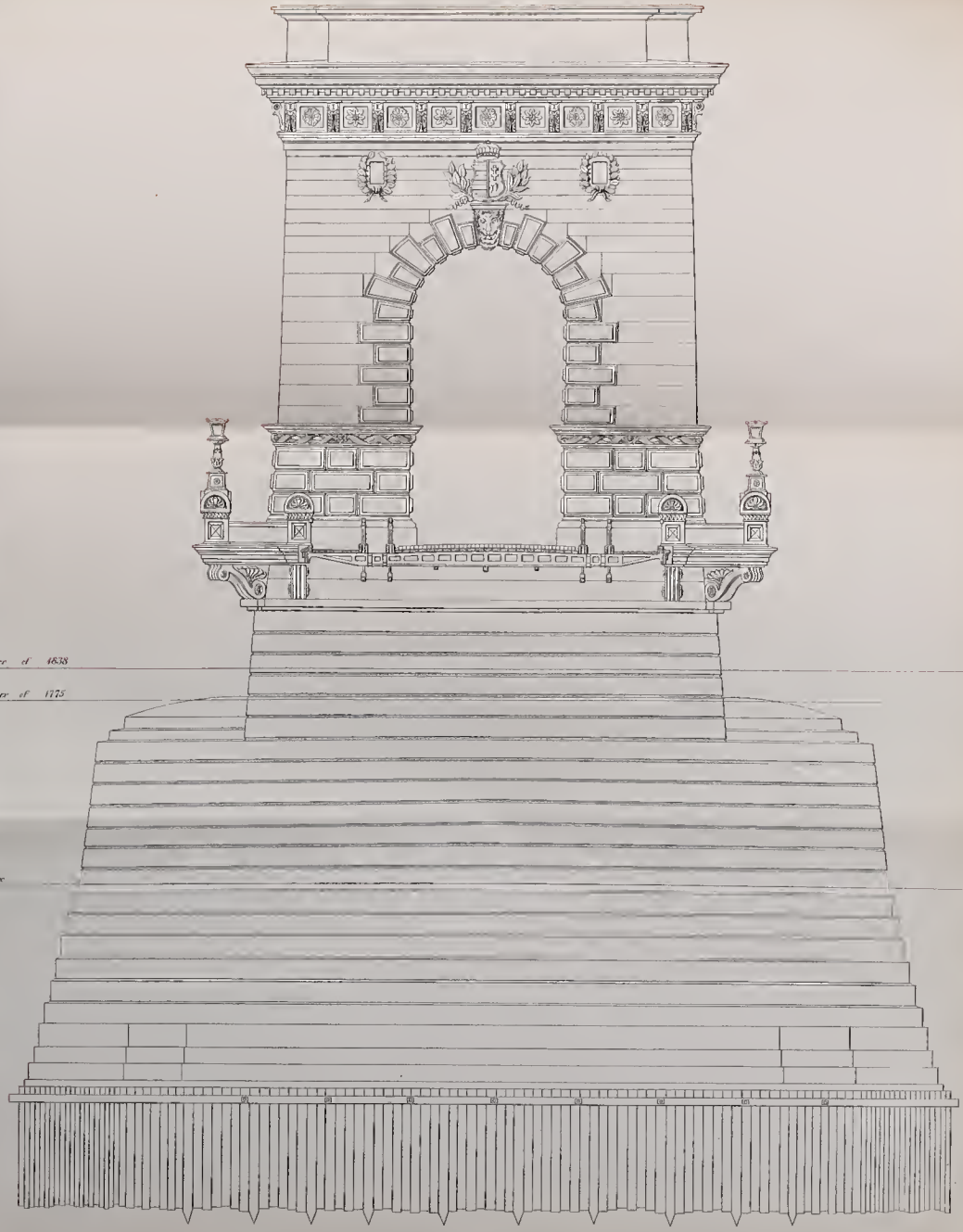
Published by J. Weale ... May 1st ...

VERTICAL CROSS SECTION
OF Nº.s 2 AND 3 PIER
SHEWING VERTICAL BOND STONES.



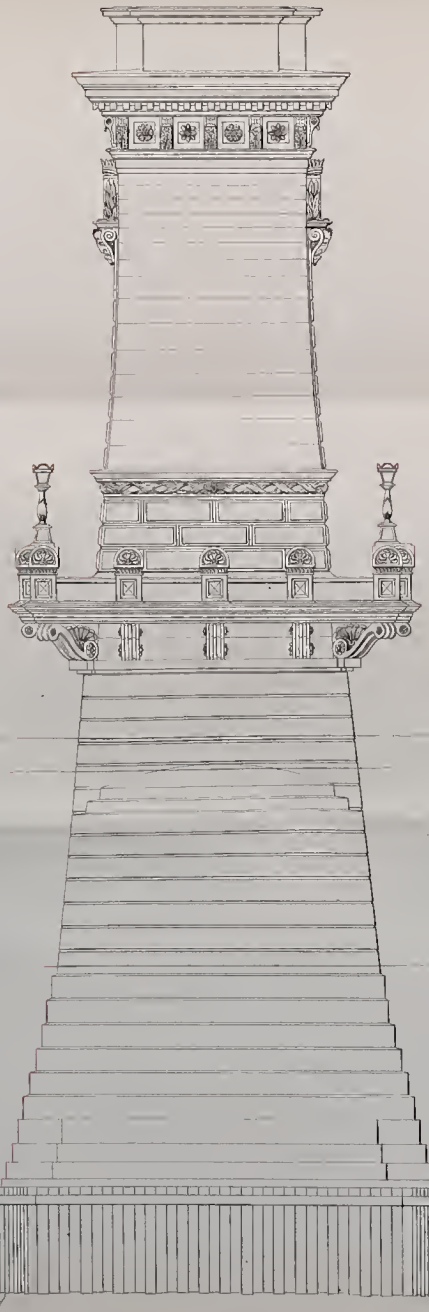
Published ... 1st ... London May 1st ...

FRONT VIEW OF PIER.



Published by John Weale London May 1st 1862

ELEVATION OF END VIEW
OF Nos 2 AND 3 PIER.



Scale of Feet.

0 10 20 30 40 50 Feet

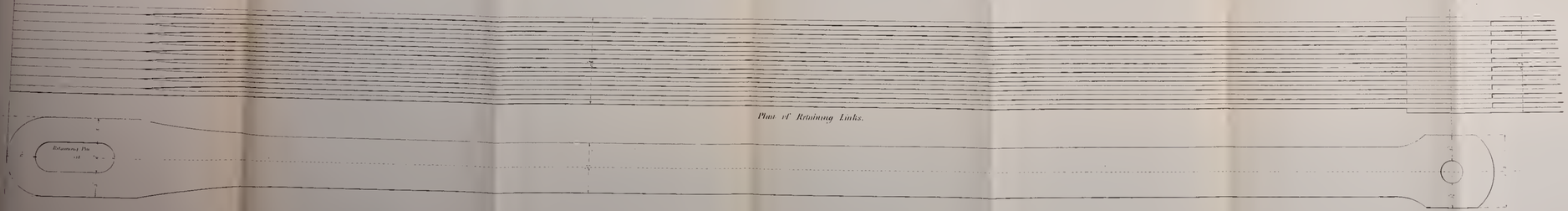
Published by John Weale, Architectural Library, 59 High Holborn.


336. 3 Length of Chain from Apex to Point of Suspension
B

PESTH BRIDGE.

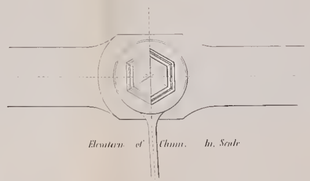
DETAIL OF CHAIN SHEWING ONE HALF ITS ENTIRE LENGTH, COMMENCING IN THE RETAINING CHAMBER AND TERMINATING AT THE APEX OF THE CENTRE OPENING.

Every Link that is 12.0 from Centre to Centre to be manufactured according to this Drawing. The thickness of each Link to be according to the several thicknesses set forth on the Drawing
All Links whether longer or shorter must have their heads or ends made to the form and dimensions here given. In Scale

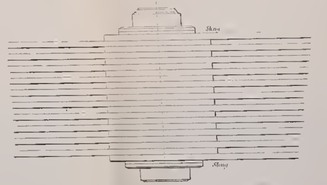


Plan of Retaining Links.

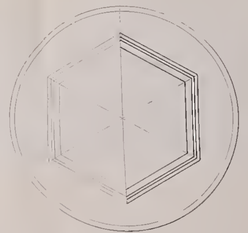
There are 87 Retaining Links required of the above form and dimensions here given. In Scale



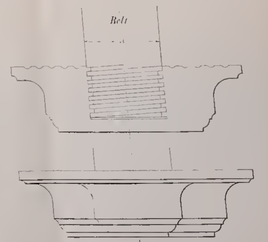
Elevation of Chain. In Scale



Plan and Elevation showing proposed method of fixing Shoes for connecting Links with Steel Iron Scrapers Nott. In Scale



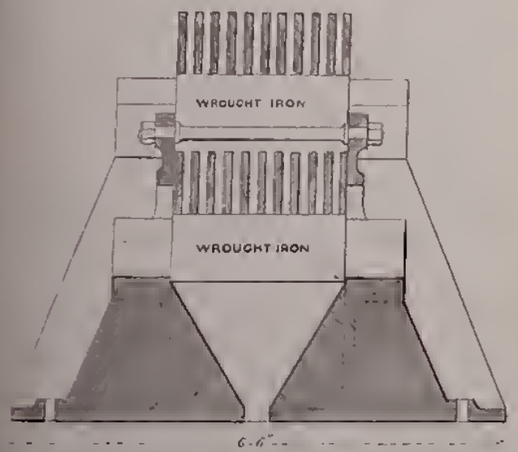
Plan of Nott

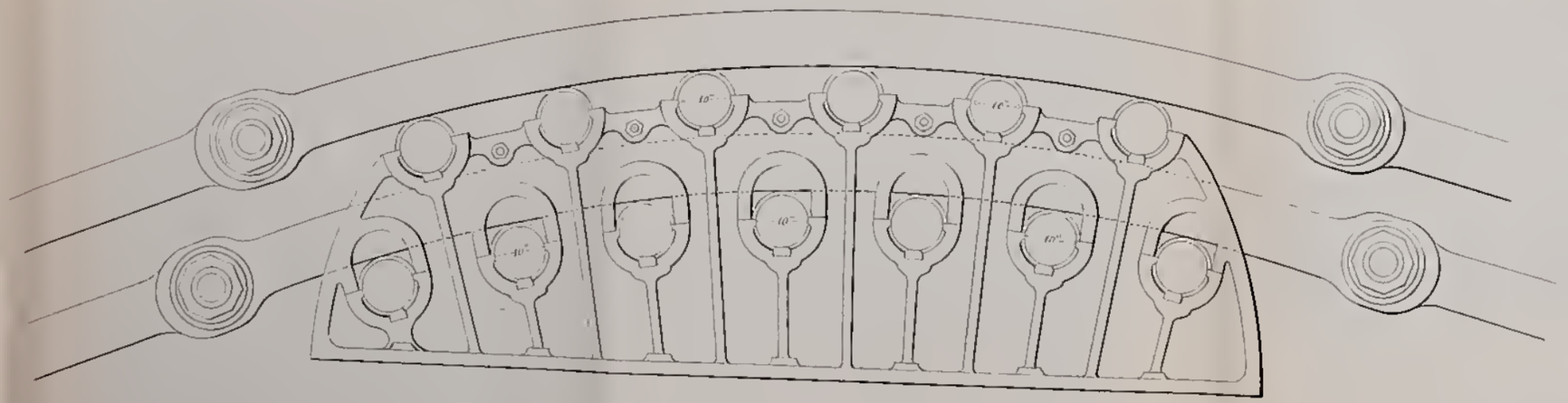


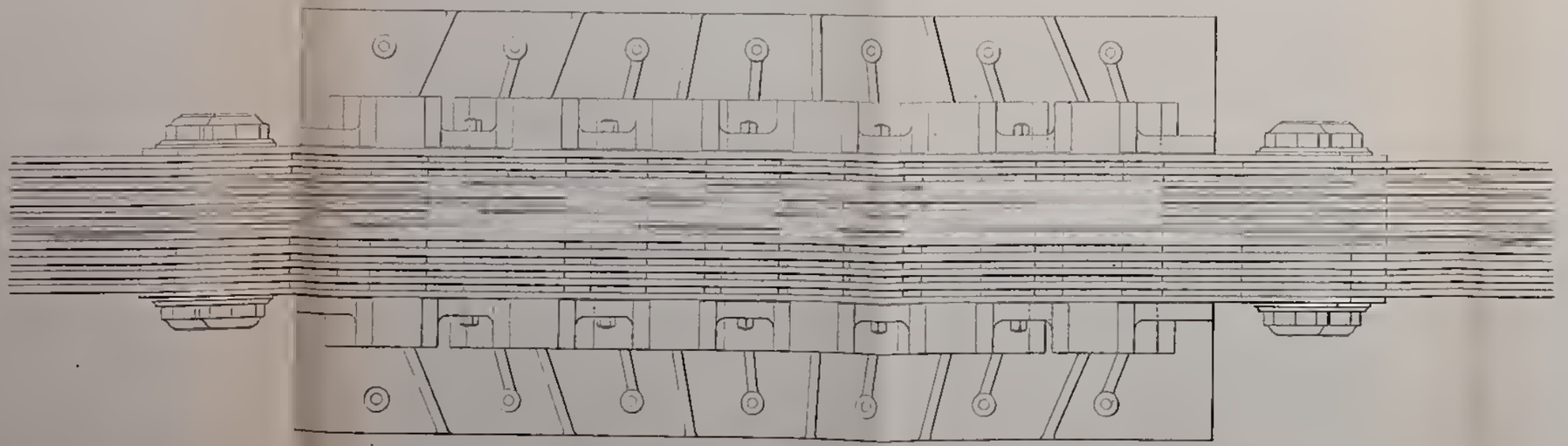
Plan and Elevation of Nott showing part of Belt with square cut thereon. Each Belt to carry in length according to the room of the thickness of the Link allowing for the Shoes
Scale ½ full size.

PLAN AND ELEVATION OF ROLLER FRAMES.

END VIEW OF ROLLER FRAME.

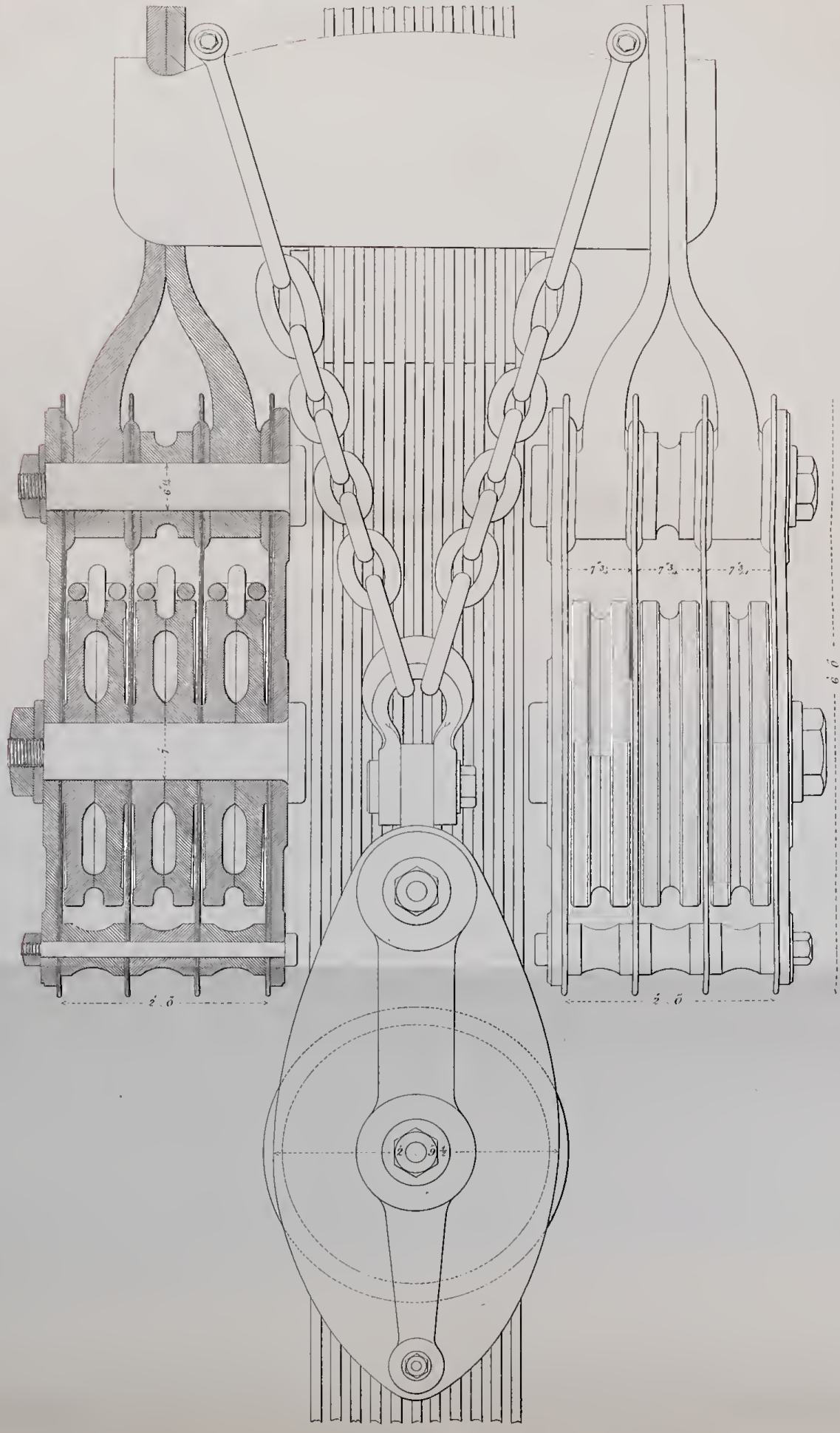






Scale of Feet

ELEVATION AND SECTION
OF A MAIN BLOCK FOR RAISING THE CHAINS.



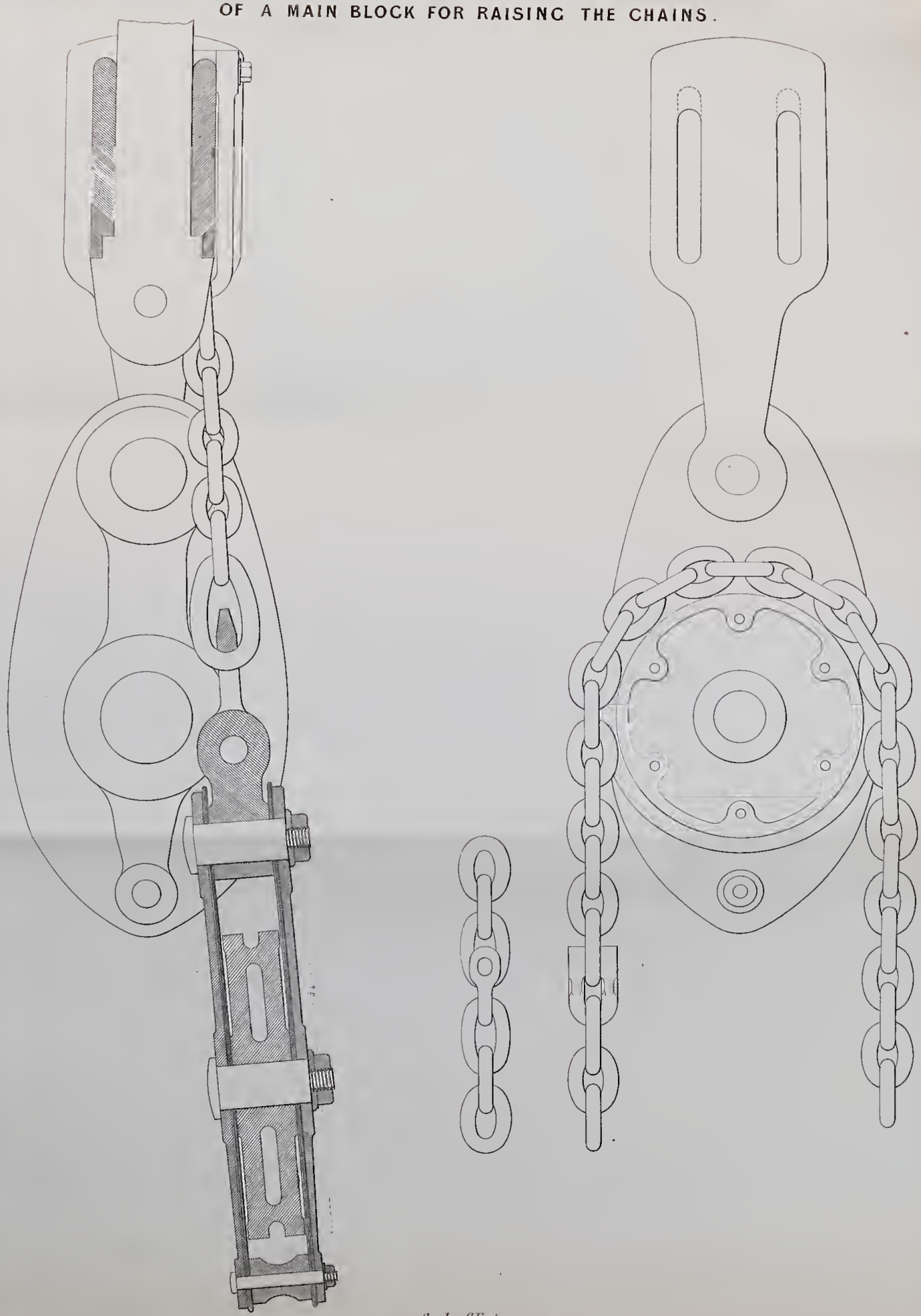
Scale of Feet.

0 1 2 3 4 5 6 7 Feet.

Standidge & Co. Litho. 36. Old Jewry.

Published by John W. [illegible] London. May 1st 1862

ELEVATION AND SECTION
OF A MAIN BLOCK FOR RAISING THE CHAINS.



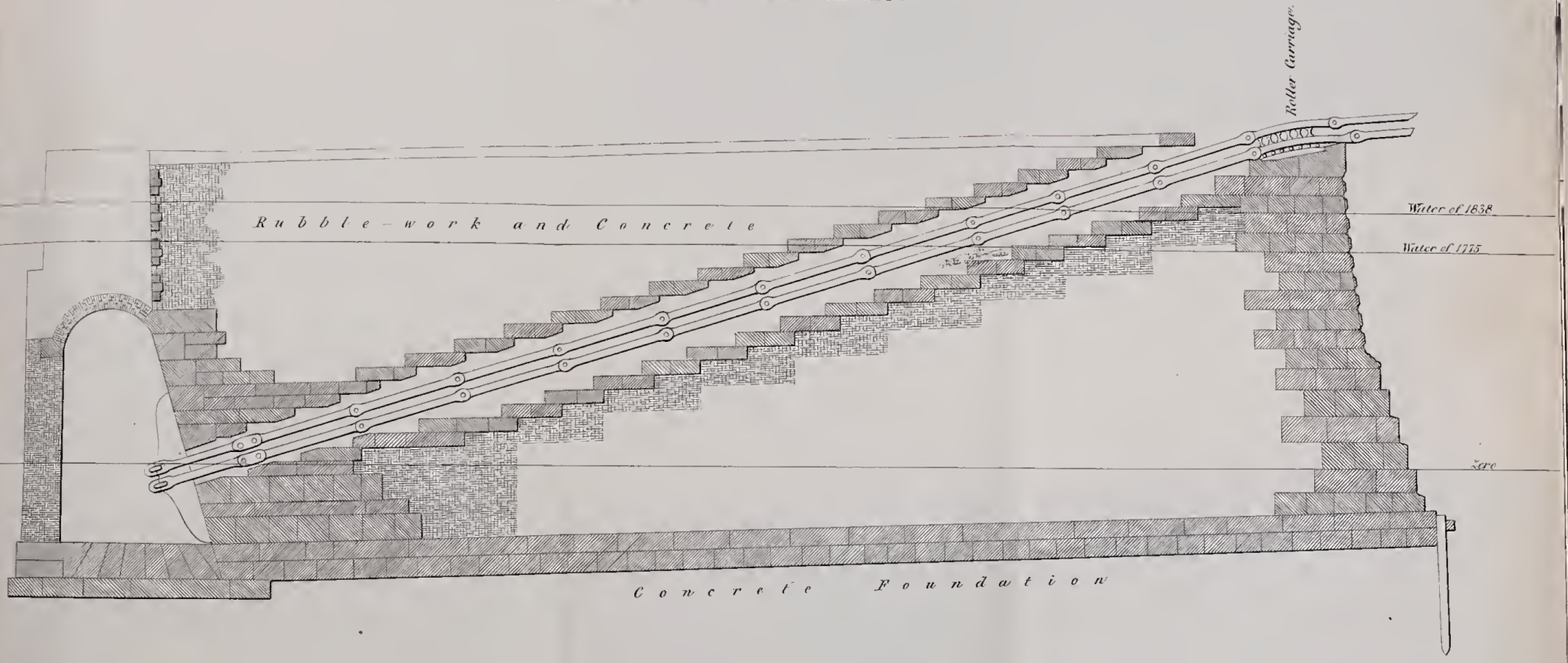
Scale of Feet.

12 6 0 1 2 3 4 5 6 Feet.

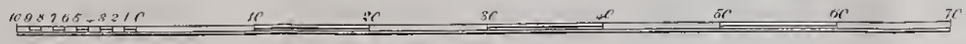
Standage & Co. Litho. 36, Old Jewry.

Published by John Weale London May 1st 1842.

LONGITUDINAL SECTION OF FIXTURE PIER.
SHEWING TUNNELS FOR CHAINS.



Scale of Feet.

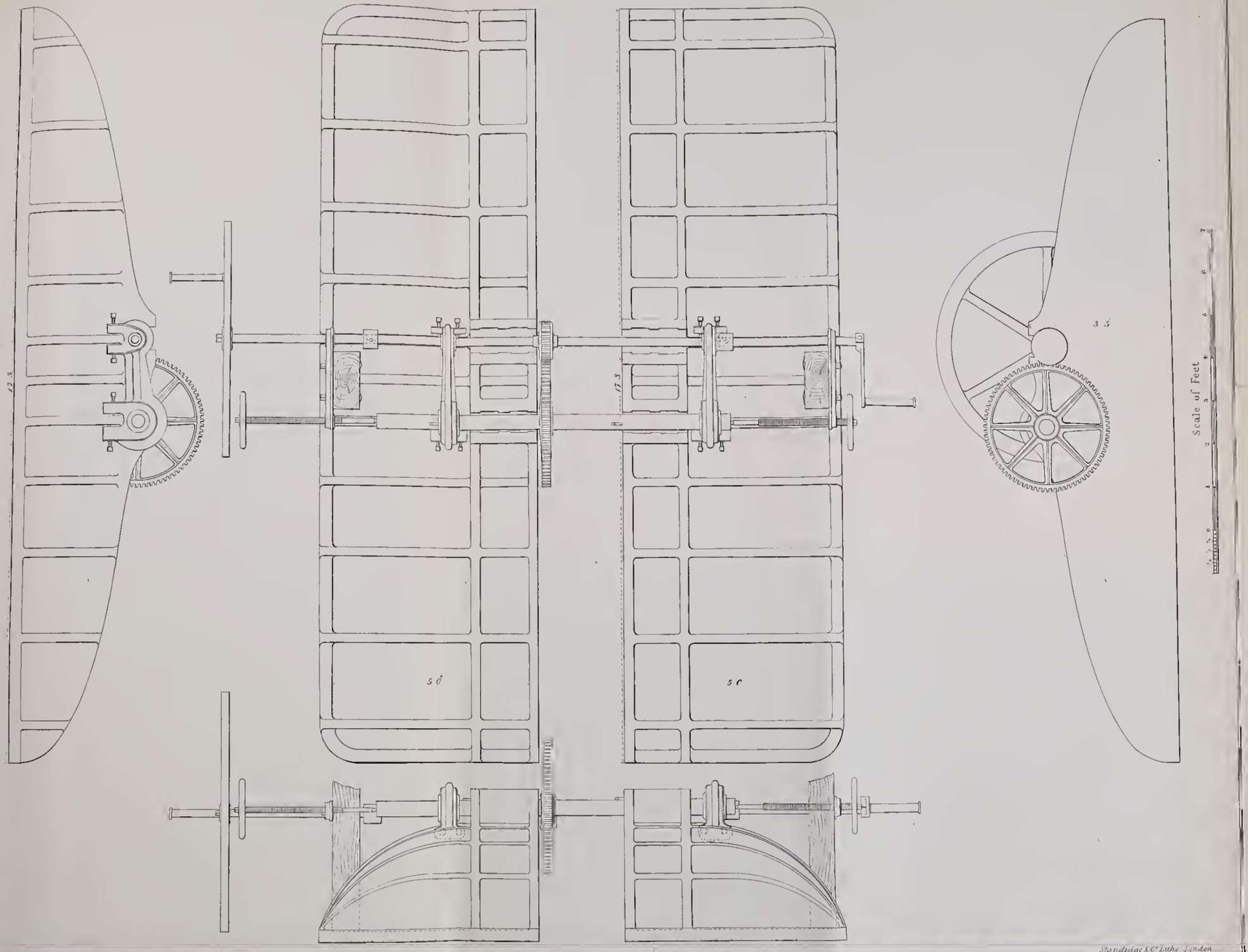


Standidge & Co. Lithrs London.

Published by John Weale, London, May 1st 1842.

PLAN AND ELEVATIONS OF RETAINING-PLATES.

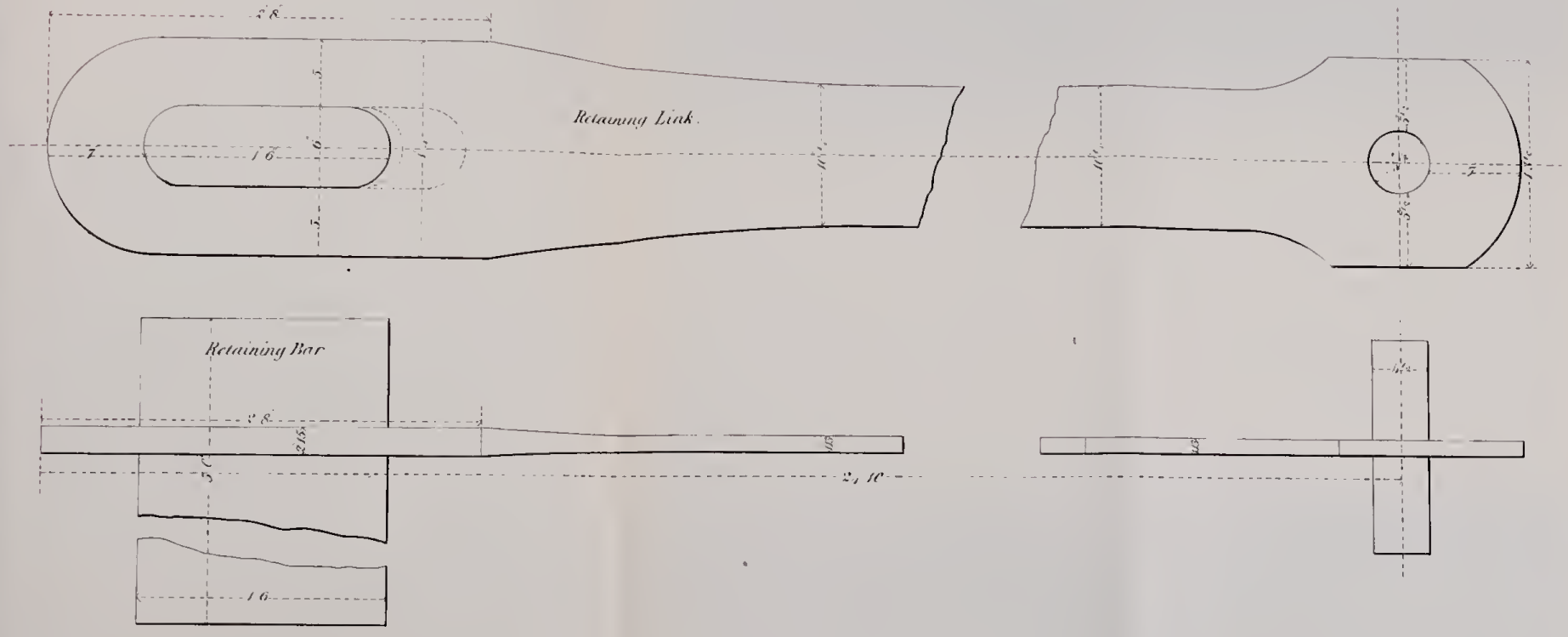
Shewing Machines for boring holes for Retaining-bars.



Standridge & Co.ª Lithe London.

Published by John Weale London. May 1st 1852

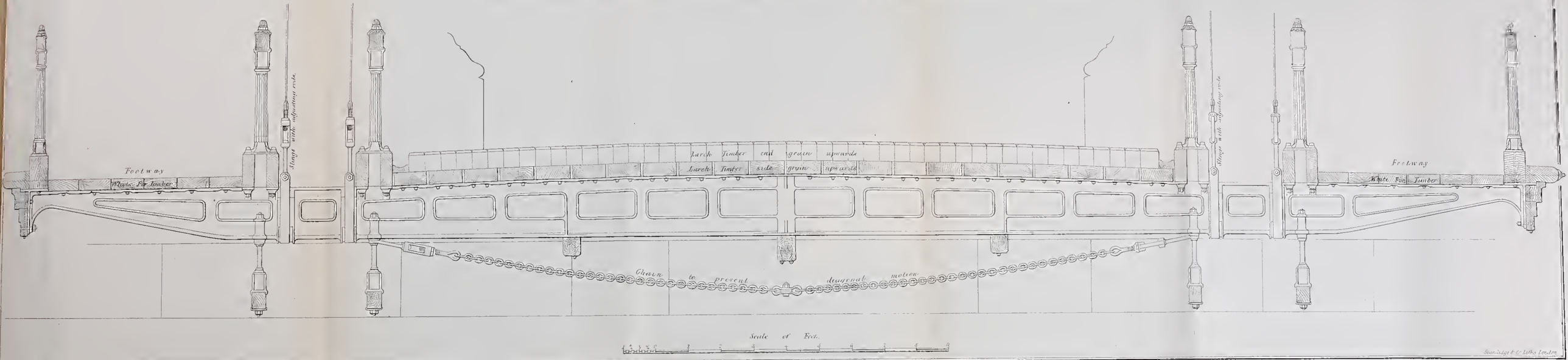
DRAWING OF RETAINING LINK AND BAR.



Standidge & Co. Lithe London.

Published by John Weale London. May 1st 1852

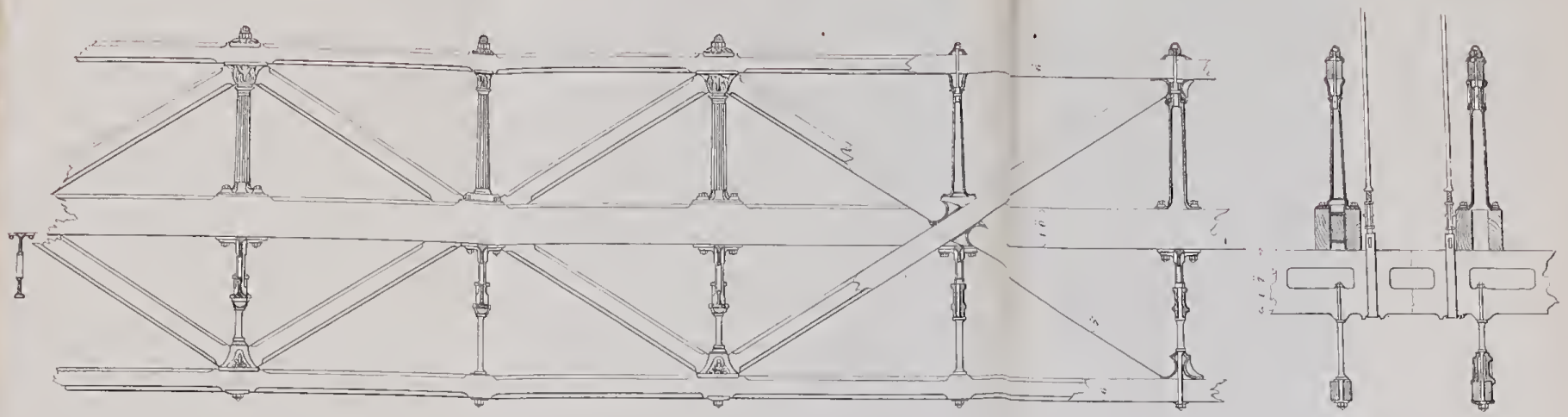
LONGITUDINAL PLAN AND ELEVATION OF CAST IRON BEAM WITH TRUSS COLUMNS.



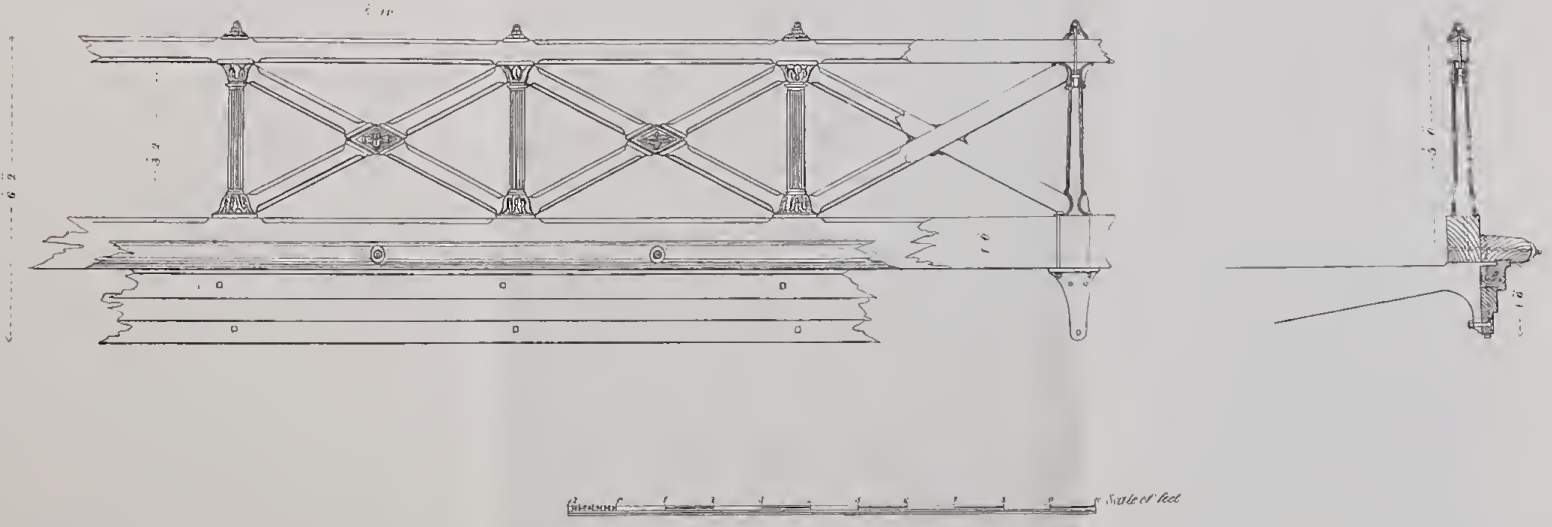
Published by John Weale, London, May 1st 1851.

Standidge & Co. Lithrs London.

LONGITUDINAL ELEVATION AND SECTION OF RUSSING.

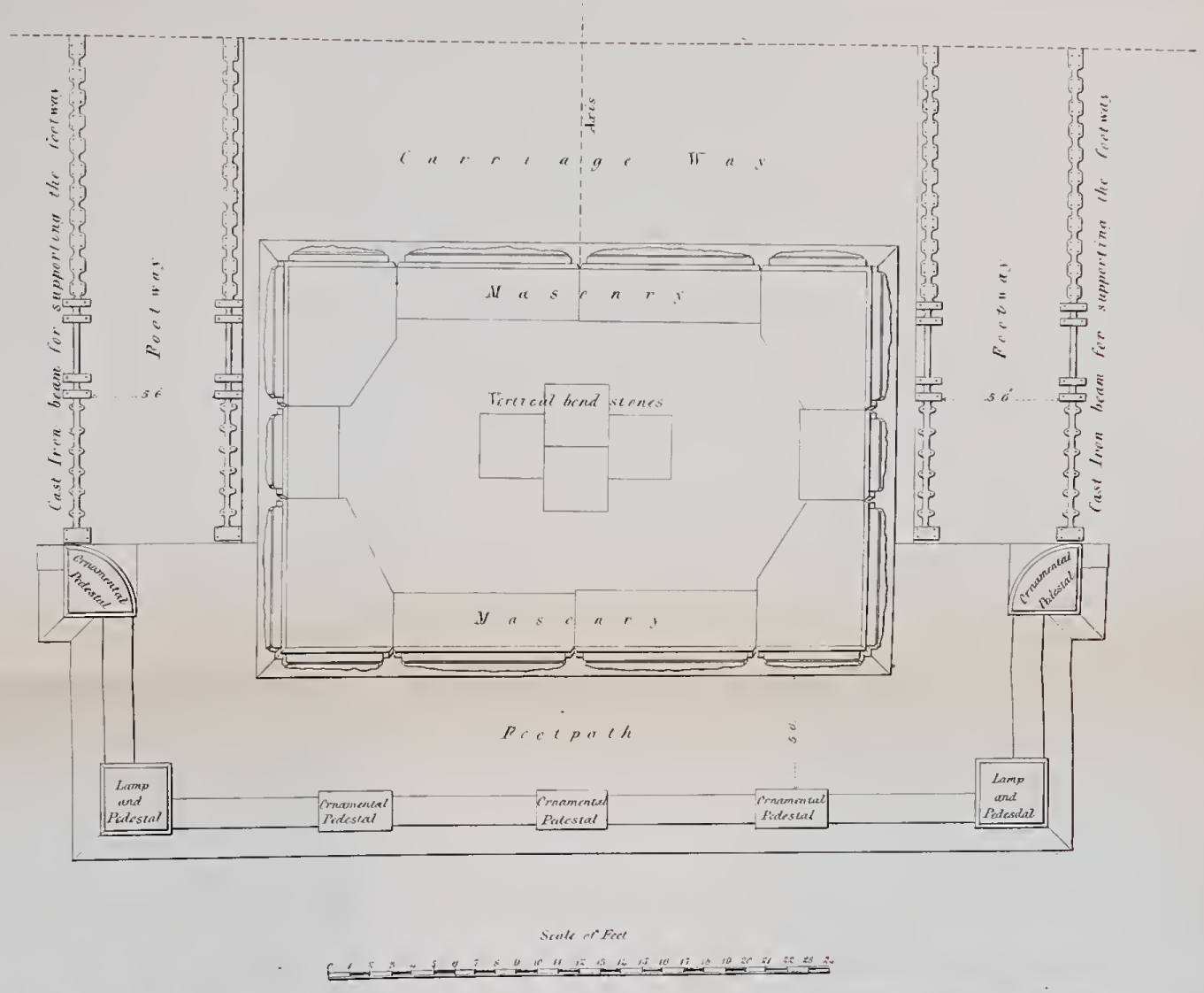


LONGITUDINAL ELEVATION OF FENCE.



Published by John Weale, London, May 1st 1850.

PLAN OF PIER AT THE LEVEL OF THE FOOTPATH.

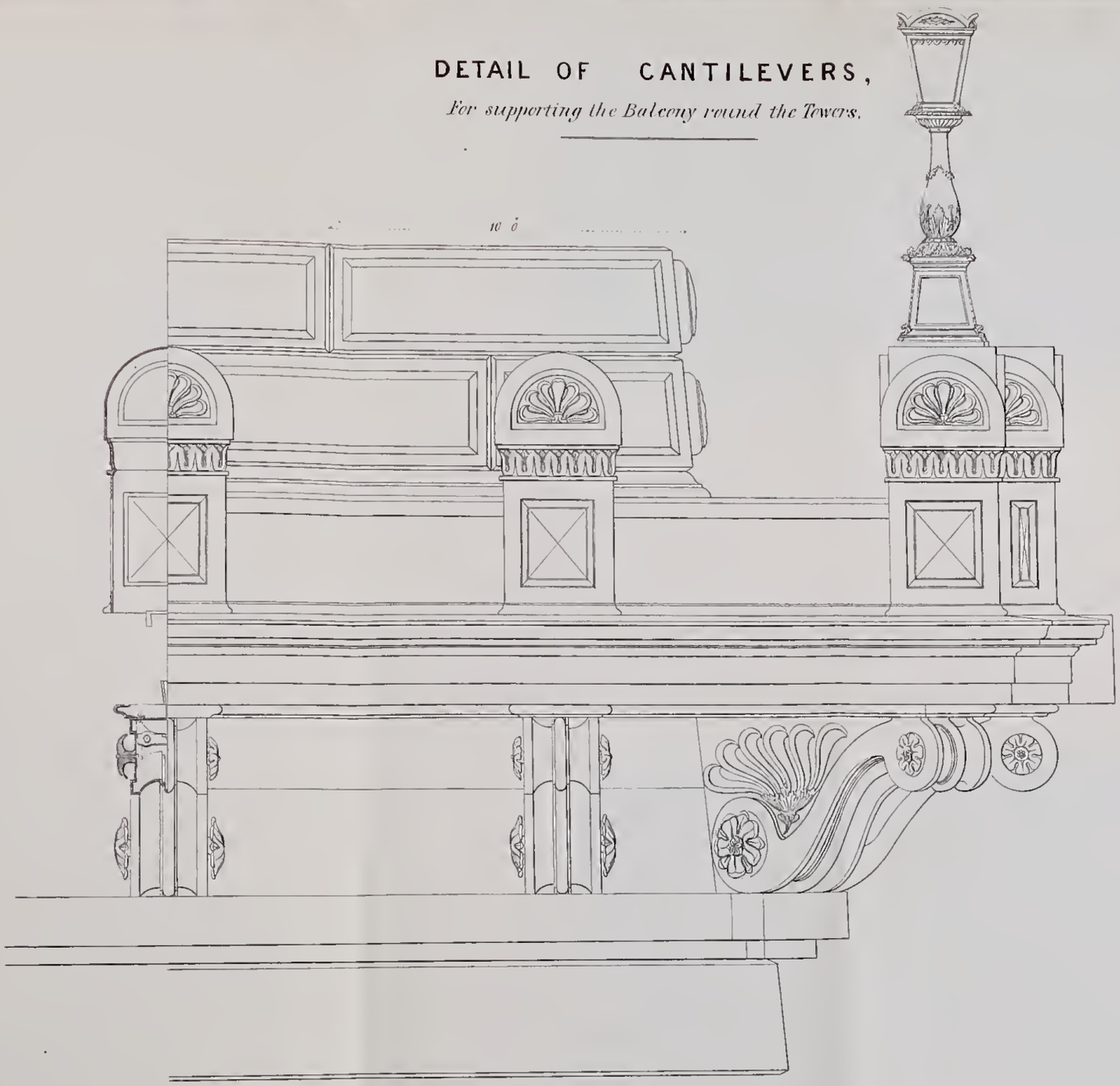


Published by John Weale London. May 1, 1842.

Standidge & Co. Lith. London.

DETAIL OF CANTILEVERS,

For supporting the Balcony round the Towers.



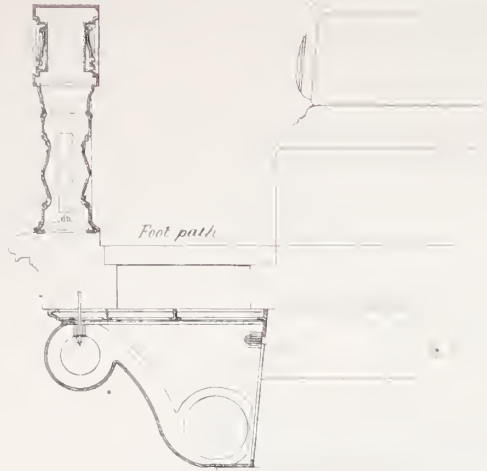
Scale of Feet

0 1 2 3 4 5 6 7 8 9 10 11

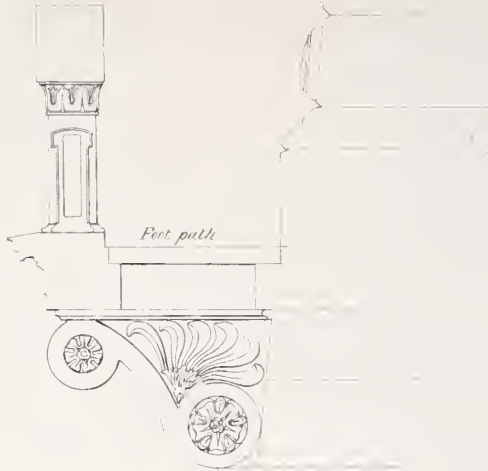
Published by John Weale, London. May 1st 1862.

Standidge & Co's Lith. London.

SECTION OF CANTILEVERS AND BALCONY.



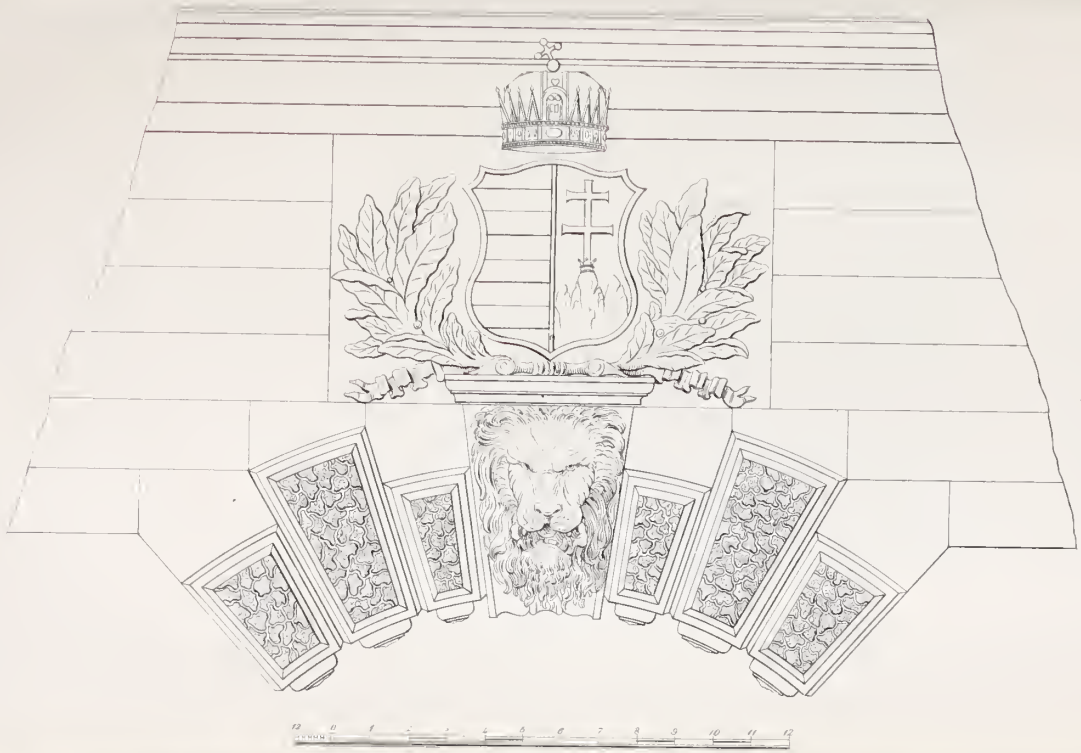
ELEVATION OF CANTILEVERS AND BALCONY.



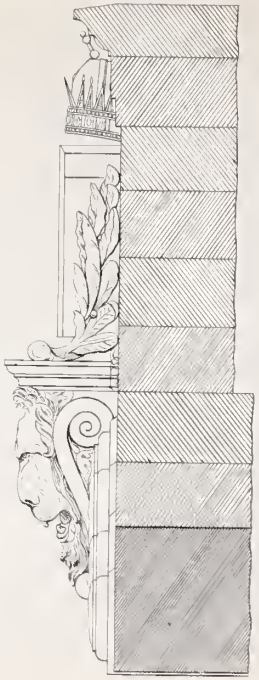
Scale of Feet

Published by John Weale, London May 1st 1841.

DETAIL OF KEY STONE AND HUNGARIAN ARMS.



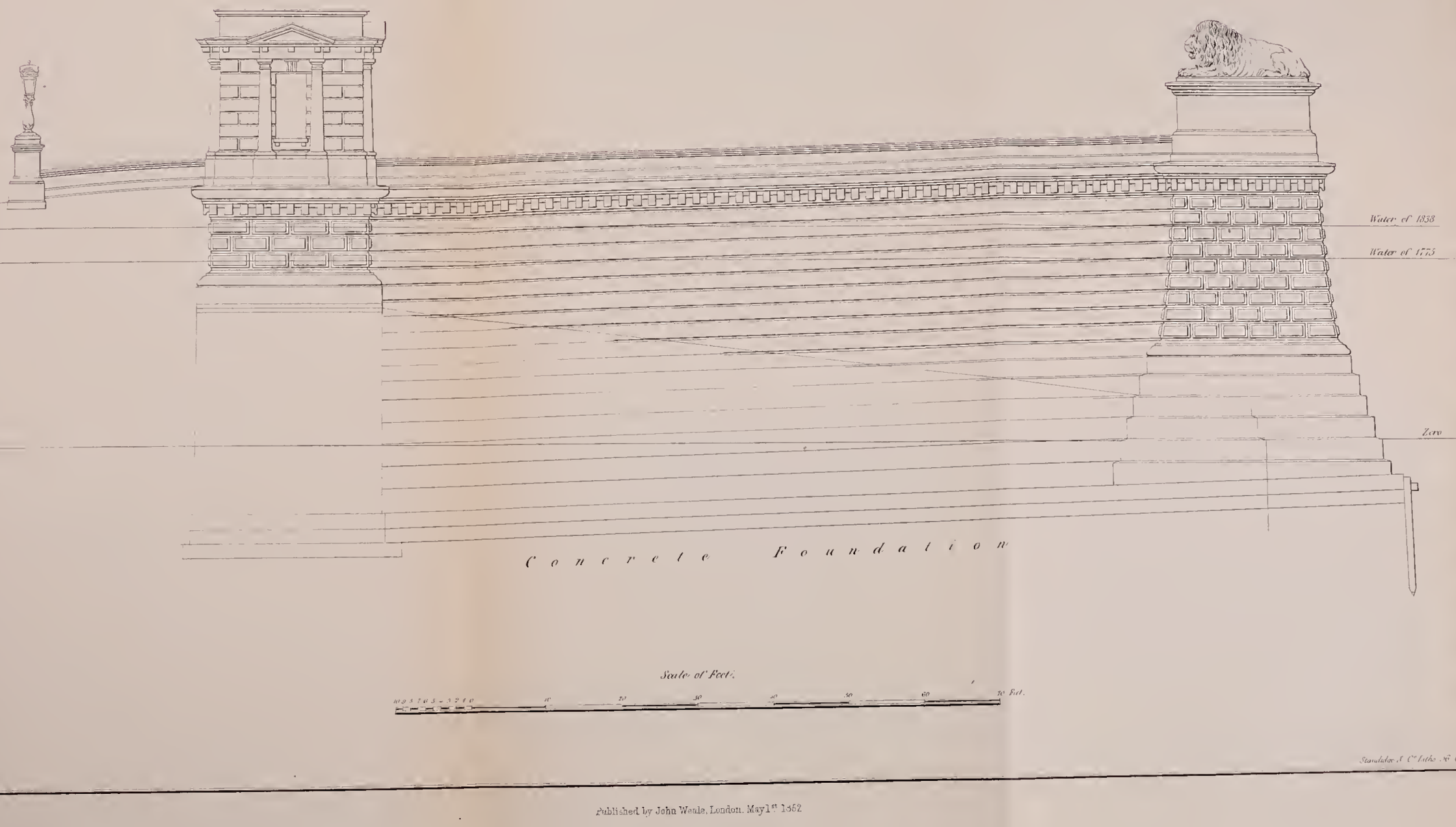
SIDE VIEW.



Stanidge & Smith Londo.

Published by John Weale London. May 1st 1842

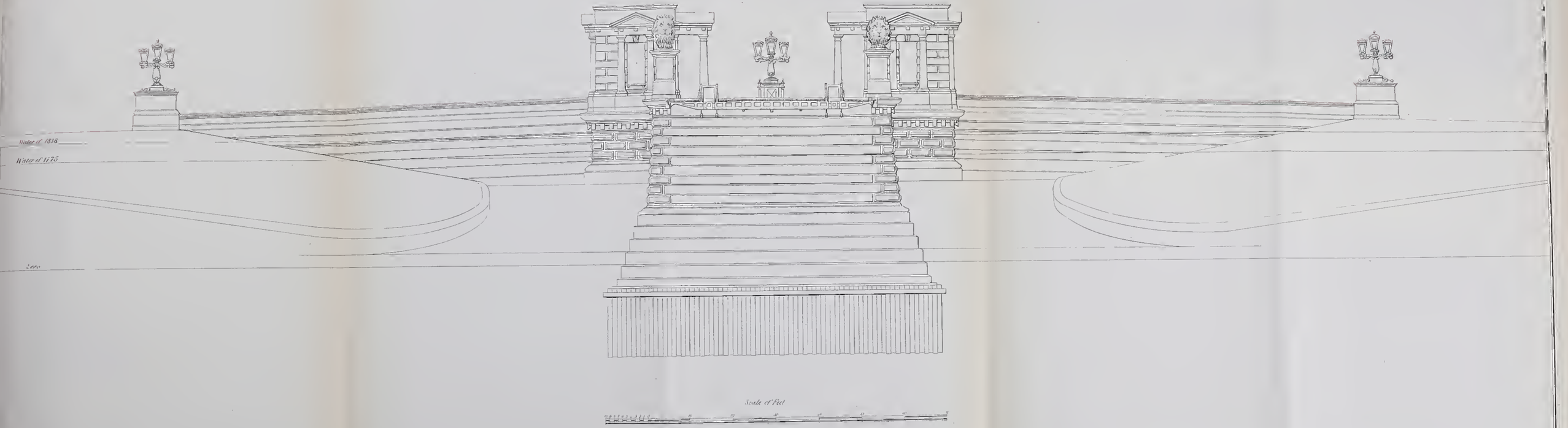
LONGITUDINAL ELEVATION OF TOLL-HOUSE FIXTURE PIER. WING-WALL AND PEDESTAL.



Published by John Weale, London. May 1st 1852

Standidge & Co.ª Lithe. 76 Old Jewry

FRONT ELEVATION OF TOLL-HOUSES AND WING-WALLS.

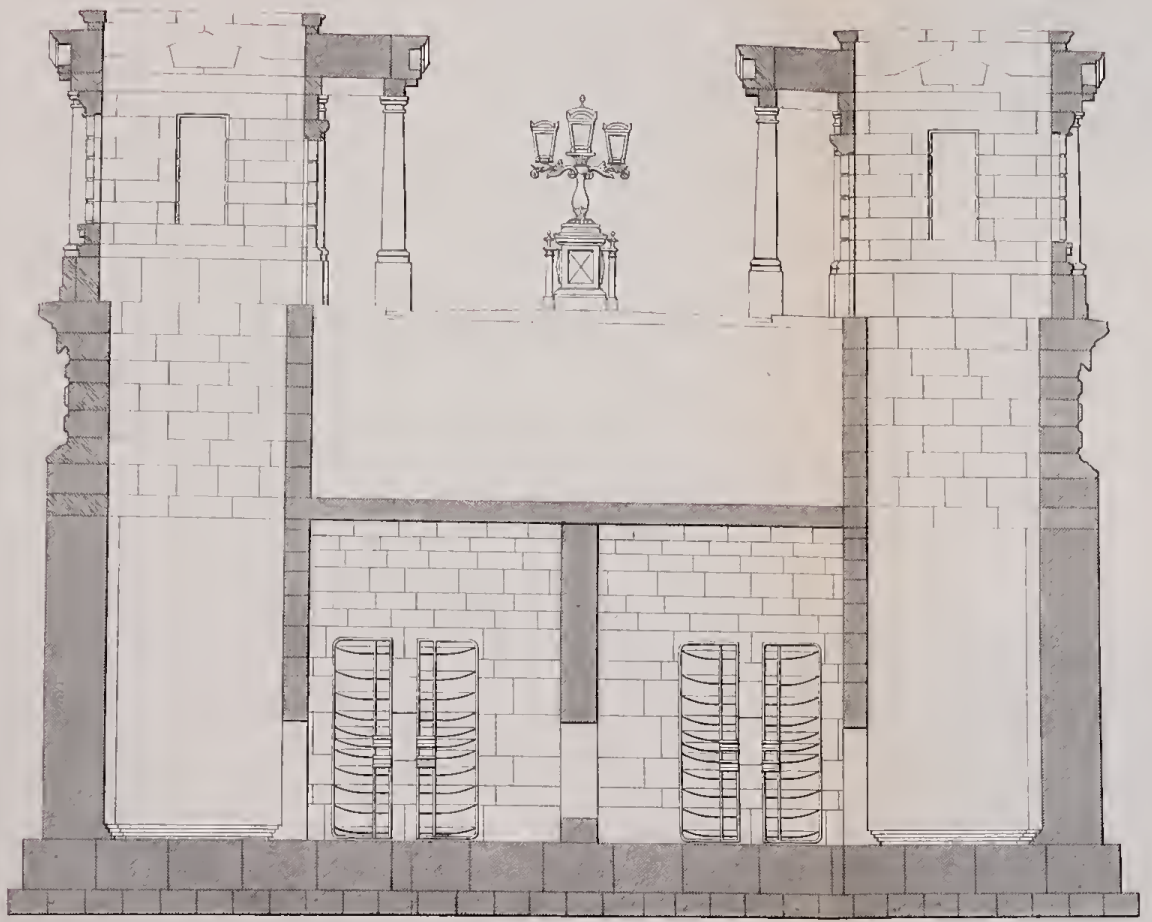


Published by John Weale, London, May 1st 1852.

Standidge & Co.'s Lithe. Old Jewry

VERTICAL SECTION OF RETAINING-PIER.

shewing Retaining-Plates and Toll-Houses.

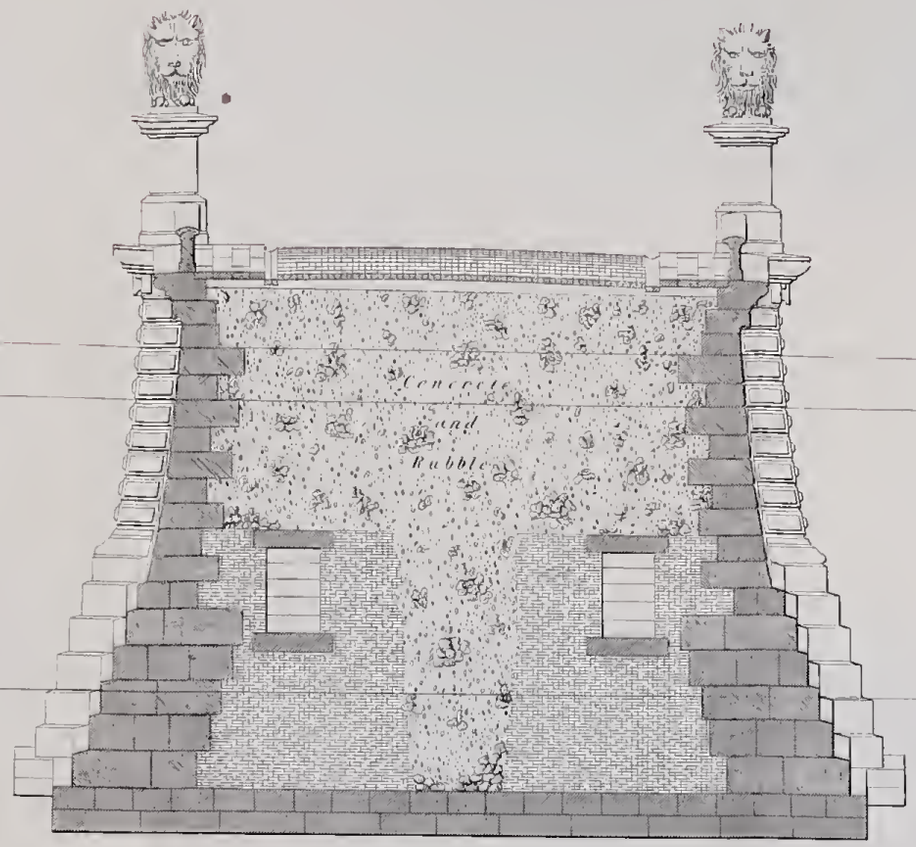


Scale of Feet.

10 5 0 1 2 3 4 5 6 7 Feet.

Standidge & Co. Litho. Old Jewry.

SECTION AT END OF FIXTURE PIER, SHEWING CHAIN HOLES.



Scale of Feet

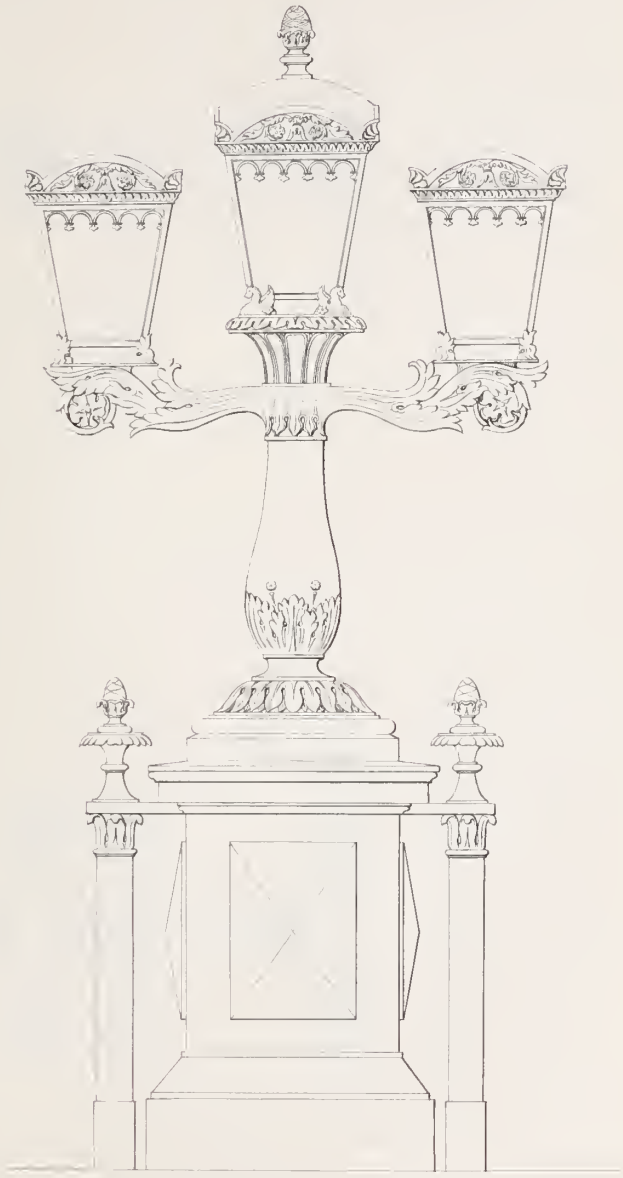
10 9 8 7 6 5 4 3 2 1 0 10 20 30 40 50 60 70

Published by John Weale, London, May 1st 1852.

Stenhouse & C°Lithe London.

LAMP AND PEDESTAL,

AT THE ENTRANCE TO THE BRIDGE.



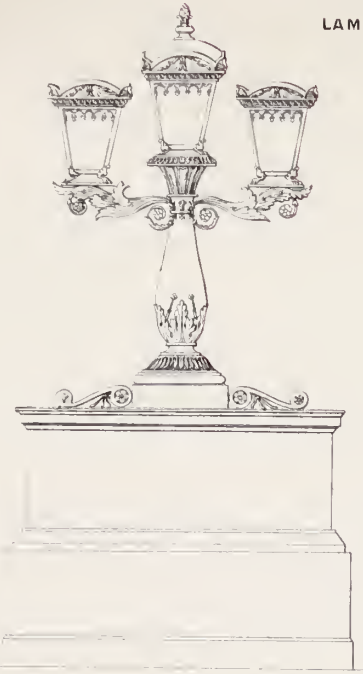
Scale of Feet

0 1 2 3 4 5

Standidge & Co. Lith. London.

Published by John Weale, ... May 1st 1850.

LAMP AND PEDESTAL AT END OF WING-WALLS.



Scale of Feet

0 1 2 3 4 5 6 7 8 9 10

Published by John Weale, London, May 1st 1852.